#

THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

FOR THE YEAR

1907.

Vol. XXXII.

WITH FIFTY-TWO PLATES

Sydney:
PRINTED AND PUBLISHED FOR THE SOCIETY
BY
F. CUNNINGHAME & CO., 146 PITT STREET,
AND
SOLD BY THE SOCIETY.

1907-08.

Jan. 1909
19028

F. CUNNINGHAME & CO., PRINTERS, SYDNEY.

LIST OF CONTRIBUTORS AND TITLES OF PAPERS.

CONTENTS OF PROCEEDINGS, 1907.

PART I. (No. 125).

(Issued June 20th, 1907.)

Note.—In Messrs. Maiden and Betche's paper in the last Part of the Proceedings (1906, p. 738) the name of the common Rough-leaved Fig should be *Ficus stephanocarpa* and not *Ficus stenocarpa*, as there printed.

PART II. (No. 126).

(Issued August 20th, 1907.)

PART II. *(continued.)*

PART III. (No. 127).

(Issued October 25th, 1907.)

PART IV. (No. 128).

(Issued March 11th, 1908).

LIST OF PLATES.

PROCEEDINGS, 1907.

LIST OF NEW TRIBAL*, SUBFAMILY†, GENERIC AND SUBGENERIC§ NAMES

PROPOSED IN THIS VOLUME (1907).

‡ See Slip opposite p.768.

‖ To be treated as synonyms.

CORRIGENDA.

Page 104, line 23—for 170. *M. centropus*, n.sp. read 170. *M. centropis*, n.sp.

Page 183, line 14—for *St. orb. β verruco sum* read *St. orb. β verrucosum*.

Page 301, line 25—*for* 14. T. QUADRILATERALIS *read* 14. T. QUADRILATERA.

Page 402, line 24—*for* ANIPIGRAPHOCIS *read* ANEPIGRAPHOCIS.

Page 742, line 4—for *Argiolestes minima* read *Argiolestes minimus*.

Page 768, line 23; Page 770, line 7 — *for* GEOCORIDÆ *read* MYODICHIDÆ.

Page 769, line 3; Page 788, line 28 — for *Thaumastotherium australicum* read *Thaumastocoris australicus*.

Page 777, line 2—*for* **THAUMASTOTHERIINÆ**, sub-fam. nov. *read* **THAUMASTOCORINÆ**, sub-fam. nov.

Page 777, line 14—*for* THAUMASTOTHERIUM, gen. nov. *read* THAUMASTOCORIS, gen. nov.

Page 778, line 10—*for* T[HAUMASTOTHERIUM] AUSTRALICUM, sp.nov. *read* T[HAUMASTOCORIS] AUSTRALICUS, sp.nov.

Page xiii., line 20 (left column of the Index)—*for* Kennedya sp. ... 52 *read* Kennedya rubicunda ... 52.

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 27TH, 1907.

The Thirty-second Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 27th, 1907.

ANNUAL GENERAL MEETING.

Mr. T. Steel, F.C.S., F.L.S., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 28th, 1906) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

The remembrance of the Society's well-sustained activities during the past year, and a hopeful outlook for the future may very well encourage us to celebrate the thirty-second anniversary in no despondent frame of mind, notwithstanding the fact that very important and unlooked for changes, affecting the personnel of the Society in almost every grade, have transpired since the last annual gathering. The removal of Dr. J. P. Hill to London, to take up the work of Professor of Zoology at University College,

following close upon that of Mr. Waite to New Zealand, has deprived us of an active worker of the stamp that we much prefer to welcome rather than to lose. Mr. P. R. Pedley, one of the oldest Members of the Council, has found it necessary to withdraw; and in starting upon his visit to Europe on a well-earned holiday Mr. Pedley will take with him our best wishes for an enjoyable and invigorating trip, and a safe return in due course.

Since the last Annual Meeting we have had to deplore the deaths of Dr. Sylvanus P. Langley, an Honorary Member, Mr. William Mitten, a Corresponding Member, the Hon. William R. Campbell, M.L.C., and Mr. Alexander Grant, Ordinary Members, and Mr. Frank E. Grant, F.L.S., and the Hon. Dr. James Norton, Members of the Council.

As philosophers we with fortitude recognise the inevitable vicissitudes—accessions and departures—which enable the guild or corporation not only to develop, but to remain intact and immortal. Still, as "units of humanity," we cannot but feel a deep sense of personal regret at the loss of our comrades and the severance of old associations.

Dr. Samuel Pierpont Langley, the distinguished Secretary of the Smithsonian Institution, and *ex officio* keeper of the United States National Museum, Washington, died on February 27th, 1906. His conspicuous success as an administrator and his zealous efforts to develop the usefulness of these great Institutions with their various ramifications, and to uphold their prestige, have amply justified his selection to carry on the work inaugurated by Professor Joseph Henry, and worthily continued by Dr. Spencer Fullerton Baird. Dr. Langley had established his reputation also as an accomplished astronomer and physicist especially interested in the problems of æronautics. His decease has removed an influential and worthy disciple of science and source of inspiration not only to his own countrymen but to the wider brotherhood of science. Professor Langley was elected an Honorary Member of this Society in August, 1891, in succession to his predecessor Professor Spencer Baird, in token of the

Society's appreciation of the inestimable services rendered by the Bureau of International Exchanges of the Smithsonian Institution, which so liberally interprets the term "diffusion of knowledge" as to recognise therein the necessary but prosaic labour of distributing the publications of Scientific Institutions, which is done entirely free of charge.

Mr. William Mitten, the accomplished English bryologist, and father-in-law of Dr. Alfred Russell Wallace, who passed away in his eighty-seventh year, at Hurstpierpoint, Sussex, on July 20th, 1906, was elected a Corresponding Member of the Society in March, 1882. His professional work, that of a pharmaceutical chemist, gave him little opportunity for travel, even as far as London; but this led him all the more assiduously in his leisure time to cultivate at home an early acquired taste for botany, until, botanically speaking, he must have come to know by heart the neighbourhood in which he was born, lived out his simple but fruitful life, and in which he ended his peaceful days. Through the influence of his friend and neighbour, William Borrer, and also of Sir William Hooker, he was led eventually to specialise in the study of mosses, hepatics and lichens; until, in this branch of botany, he became one of the leading British authorities. His published papers are very numerous; and one of them, entitled "Musci Austro-Americani," by itself takes up the entire twelfth volume of the botanical portion of the Journal of the Linnean Society of London (1869). His more important papers on Australian non-vascular cryptogams are "A List of the Musci and Hepaticæ collected in Victoria, Australia, by Dr. F. Mueller (in Hooker's Journ. Bot. viii. 1856, pp.257-266); "Descriptions of some new species of Musci from New Zealand . . . together with an enumeration of the Species collected in Tasmania by William Archer, Esq.," &c. (Journ. Linn. Soc. Bot. iv. 1860, pp.64-100); also the "Hepaticæ," and in conjunction with the Rev. C. Babbington, the "Lichenes" of Hooker's "Flora Tasmaniæ" (1860). In addition to these, his contributions to knowledge include studies on some or other of these groups from New Zealand, Fiji, and Samoa; as well as from Japan, and Mt.

Kinibalu in Borneo. To Mr. Botting Hemsley's "Report on the Botany of the Challenger Expedition," Mr. Mitten also contributed the portion dealing with the hepatics and mosses.

Mr. Mitten has thus furnished us with a brilliant and inspiring example of the useful and necessary amateur at his best, and of the extraordinary amount of good work that can be successfully accomplished during the frequently interrupted leisure of a long lifetime by the patience and concentration of an enthusiast. I may conclude my remarks upon this estimable man by a brief quotation from a biographical sketch, contributed to the "Journal of Botany" (for October, 1906) by Mr. Botting Hemsley, who says of Mr. Mitten—"He had correspondents in all parts of the world, from whom he received many things besides mosses, including seeds for his garden, of which he was very fond. I remember how keenly he examined his mosses and liverworts for chance seeds of other plants, and how much pleasure he derived from observing their germination and growth. In this way he raised several things from remote islands visited by the 'Challenger' Expedition."

The Hon. William Robert Campbell, M.L.C., a member of an old Sydney family, who died on July 30, 1906, aged 68, joined the Society in October, 1878. At this time he was the owner of Trigamon Station, near Warialda; and becoming interested in the occurrence of fishes in a dam unconnected with any water-course, and which had been dry a few months previously, he forwarded specimens to Sir William Macleay, who determined them to be referable to a species of *Therapon* (*T. unicolor* Gthr.), and published a short account of them in the Society's Proceedings (Vol. iii. p. 15). Upon relinquishing the life of a squatter, and taking up his residence in Sydney, Mr. Campbell developed a lasting interest in matters relating to fish and fisheries. For some years, and until its abolition, he was a member of the old Board of Fisheries; and a few months before his death he was elected to the existing Board, in succession to the late Hon. John Want, M.L.C. Mr. Campbell was elected to the Legislative Assembly, as Member for West Sydney, in 1868. From Novem-

ber, 1880, until his resignation in May, 1886, he was the representative of the electorate of Gwydir. In April, 1890, he was appointed to a seat in the Upper House. As a public man, and as a public-spirited citizen, Mr. Campbell enjoyed the respect and esteem of those who knew him or were associated with him in public life. Sir William Macleay and Mr. Campbell married sisters, two of the daughters of the late Sir Edward Deas Thomson, C.B., K.C.M.G. Mr. Campbell's death has thus deprived the Society of a member more nearly related to Sir William Macleay, than by the tie of personal friendship.

Mr. Alexander Grant was born at Cullen, Banffshire, Scotland, in 1844. He served his apprenticeship as a horticulturist in the celebrated gardens of the Earl of Seafield, Cullen House, being afterwards engaged as gardener in the Royal Botanic Gardens, Edinburgh, during the curatorship of Mr. McNab. His skill as a microscopist at this time led to his employment in the preparation of botanical microscopical material for the University students who attended the gardens for special study. After his arrival in Sydney, in 1878, he was employed for several years as a private gardener, and in 1882 joined the staff of the Sydney Botanic Gardens. Mr. Grant made a special study of fungi and was honorary custodian of the plants of this group in the National Herbarium. He was a Vice-President of the Horticultural Association of New South Wales since its foundation. Mr. Grant died on Christmas Day, 1906.

The comparative absence in Australia of a wealthy leisured class gives fewer unpaid workers to science in proportion to professionals than is the ratio in Europe. Those we have are busy men who, after their day's work is done, devote spare hours or holidays to study. One such, a brilliant amateur, was lost to our little band of workers when Frederick Ernest Grant succumbed, after a brief illness, on 31st January last. Mr. Grant was born 23rd March, 1866, at Farlesthorpe, Lincolnshire. In 1883 he accompanied an elder brother, engaged in pastoral pursuits, to New Zealand, and five years later entered the service of the Union Bank. His love for natural science was strong from boyhood. During

his residence in Auckland he collected actively, and possessed a good knowledge of the local fauna. Transference to the Melbourne office opened for him a wider intellectual horizon, which he much appreciated. He attended the science courses at the Technical College and became an active member of the various scientific societies. At the excursions of the Field Naturalists his was a prominent and popular figure. In the Royal Society he rose to be a member of council. His artistic abilities were at the disposal of his friends, and he illustrated various papers by Messrs. Pritchard and Gatliff. Conchology and geology were at first his favourite subjects, but when Mr. T. S. Hall pointed out to him that these sciences had their devotees, while the crustacea lacked a local student, he turned his energies to carcinology and worked steadily at it for the rest of his life. In 1902 he enjoyed extended official leave and re-visited England. The British carcinologists, who recognised the merit of his work and its future promise, gave him cordial greeting. He studied the Australasian crustacea at the British Museum and made voluminous notes thereon. In 1902 he was elected a Fellow of the Linnean Society of London. Shortly after his return to Australia the Bank transferred him to Sydney. At once he took an active share in our scientific life, was elected member September 30th, 1903, and on the death of Mr. Trebeck succeeded to the vacant seat on the Council. In 1904 he helped to organise an expedition to examine the fauna of the Great Barrier Reef, and with the assistance of Mr. A. R. McCulloch presented to the Society a report on the Crustacea of Mast Head Island. At the time of his death he was busy with a second collection from the Barrier. He accompanied two deep-sea dredging expeditions. His report on the first is incorporated in our Proceedings; that on the second he did not live to finish. An article on the crustacea of Norfolk Island had just been completed before his decease and will be presented to the Society at an early date. He leaves a widow and three children.

The Hon. James Norton, LL.D., M.L.C., was born in Sydney, on December 5th, 1824. His father was an English solicitor, who came to Sydney in 1818 to practise his profession. At this

time the legal fraternity in Australia comprised two English solicitors who received a retaining fee from the English Government as an inducement to take up the practice of law at the Antipodes. James Norton, jun., was articled to his father in 1843, was admitted as a solicitor in 1848 and subsequently taken into partnership. On his father's death in 1862, he succeeded to the business; and, with his partners, he ever afterwards worthily upheld the good name of the important practice so successfully initiated by his father. In 1879 he was called to the Upper House, and in 1884 he became Postmaster-General in the Stuart Government. Outside the field of politics, Dr. Norton patriotically served the State in several capacities—as a trustee of the Australian Museum from 1874; as a member of the Board of Trustees of the Free Public Library from 1878, and of which he was chairman at the time of his decease; and as a trustee of Hyde, Phillip and Cook Parks for many years, as well as in other ways. In his early days he seems to have developed a taste for natural history, which provided him with a never-failing hobby for the rest of his life. Some thirty years ago, when the publication of the "Flora Australiensis" made it possible for Australian students to take up the study of indigenous plants with satisfaction and profit, Dr. Norton was one of a small band which included Professor Stephens, Mr. R. D. Fitzgerald, Mr. Edwin Daintree and a few others whose names are not now ascertainable, who met together informally from time to time, to study and compare their collections, and to exchange experiences, with a view to mutual help and encouragement. He was an ardent horticulturist, and took great pride in the beautiful trees and shrubs, especially those of indigenous species, which he cultivated in his fine old garden, and many of which he had himself planted. The spring flowering of his magnificent collection of Cape bulbs furnished an annual occasion for assembling and extending a hearty welcome to his many friends. The natural history of his country home at Springwood was a perennial source of delight and refreshment. He spared and safeguarded the welfare of all the most attractive native plants on his estate,

and completed the task of compiling a census of its flora. His observations on the birds were partially embodied in a paper entitled "Australian Birds: Useful and Noxious," read at the "Conference of Fruit-growers and Vine-growers" held in Sydney in June, 1890, and published in the Report thereof (p. 245). This interesting article concludes with some emphatic remarks upon the unrestricted and inconsiderate acclimatisation of undesirable alien species of plants and animals—a subject upon which, as a community, even to this day, we are so slow to learn wisdom. At the monthly meeting in July, in formally announcing his decease, I referred to Dr. Norton's long and honourable connection with the Society, of which he was the oldest surviving original member; to the Society's indebtedness to him for valuable services rendered in various official capacities; and to his unwavering support to and interest in the Society and its welfare. Dr. Norton was an observer rather than a writer; but the needs of a Society like this are so varied that the co-operation of members with similar qualifications, and with such ripe experience and general knowledge, is a most important source of strength.

The three extraordinary vacancies in the Council, due to the removal of Mr. Waite and Dr. Hill from the State, and the decease of Dr. Norton, were filled by the Council's election of Messrs. A. G. Hamilton, R. H. Cambage and Professor J. T. Wilson, in the manner prescribed by the Act of Incorporation, as announced in due course to the Members. In accordance with the provisions of Rule xvi., these gentlemen are included among the six retiring Members of Council for the year. More recently the retirement of Mr. Pedley, and the decease of Mr. Grant have caused two additional vacancies which remain to be filled on the present occasion, as Members have already been notified by circular.

Six (nominally seven) Ordinary Members, and one Associate Member were elected during the year, so that our numbers remain practically stationary. The thirty-seven papers read before the Society have been published, Part 4 of the Proceedings for 1906, containing the last instalment of them, being now ready

for distribution. They presented a wide range of subjects for consideration, and in some cases called for ampler opportunities for discussion than the time available at the Meetings allowed, or until those interested had had the opportunity of seeing the papers in print. As soon as provision can be made for it, a special opportunity for discussing the topics treated of in the papers by Messrs. Andrews, Halligan, Taylor, and Dr. Woolnough will be afforded; and an announcement upon the subject may be looked for at the next Meeting.

The additions to the library for the year amounted to a total of 1,471 (including 127 Vols), received by gift or exchange from 203 Societies, &c., and 16 individuals.

Notwithstanding the fact that the time for repainting and renovating the exterior of the Society's premises arrived during the year and was duly provided for, I am glad to be able to say that the Hon. Treasurer will be able to announce presently that we began the current year with a credit balance from last Session.

During the year that has passed, the Macleay Bacteriologist has been engaged upon researches connected with that important bacterium, the nodule-former of the *Leguminosæ*. Although the presence of slime in the cells of the nodules and the occurrence of the same in artificial culture under certain conditions, have been known for some time, the real significance of the slime has not hitherto been demonstrated. His first research showed that the slime formed by the microbe contained as its essential constituent, a gum which appeared to approximate in some respect to the carbohydrate of certain nucleoproteids, and on this account the slime in the nodule probably serves to build up the nucleoproteids of the leguminous plant. Using the formation of slime as an index of the activity of the bacterium, it was shown that the bacteria from the nodules of various leguminous plants differed from one another physiologically. But from the fact that three European races of the micro-organism, which had been induced to reassume their slime-forming property in the laboratory, were physiologically identical, it is evident that the physiological function is mutable, and that the bacterium may adapt itself

sooner or later to the conditions that occur within the root-hair and the nodule. There are great differences in the facility with which various races can produce slime under laboratory conditions. As some races do not form it at all, there is reason to believe that the failure of trade cultures of "Nitragin" has in the past been in part at least due to the fact that the importance of the slime-forming function has not been recognised. As they come from the nodules of various plants of the same species, the bacteria may be similar, just as they may be similar when taken from nodules of the same plant. But that such is not always the case, was shown by three distinct races having been obtained from a single nodule. The hypothesis has been advanced that the plant utilises the intracellular albuminoids of the bacterium for its nutrition. Dr. Greig-Smith has shown that this is not probable, for although the great majority of the bacteria and bacteroids are dead during the active growth of the plant, they still stain deeply, and therefore cannot be in process of solution. As the slime is nitrogenous, there can be no doubt that the hypothesis advanced by Mazé is correct, and that the slime is the means by which the nitrogen is conveyed from the bacterium to the plant. The inner structure of the bacterium has given rise to much speculation, and latterly its sporangium nature has been advanced. Mazé was the first to illustrate it as consisting of coccobacteria within a branching capsule. The Macleay Bacteriologist has shown that it consists of cocci within a branching capsule, and is therefore allied to *Leuconostoc* and *Streptococcus*. It has been shown that the most suitable medium for growing the slime is one which approximates in its nitrogen and salt content to soil-water, so that, while the bacterium is vegetating in the soil, the alkalinity and nutrients will sustain the slime-forming function. The carbohydrates of the root-hair are the chemotactic substances which induce the bacterium to enter the plant. A second research showed that the bacterium was capable of fixing atmospheric nitrogen upon synthetic media under certain conditions. These also induced the formation of slime. Races of the microbe which, while multiplying freely,

could not form slime from particular nutrients, were incapable of fixing nitrogen, but when they did form slime from other nutrients a fixation also occurred. The presence of another bacterium, itself incapable of forming slime or of fixing nitrogen, increased the slime formation and the fixation of nitrogen. Finally, the fixation of nitrogen was proportional to the formation of slime. A number of lower forms of plant life are known to be capable of enriching the soil by fixing atmospheric nitrogen, and among them, *Azotobacter chroococcum* is possibly the most vigorous. The Macleay Bacteriologist has confirmed the researches of Beijerinck upon this micro-organism, and has also drawn attention to the fact that the nodule-former of *Leguminosæ* is quite as capable as *Azotobacter* of fixing nitrogen while it is vegetating in the soil.

Three pupils availed themselves of the facilities afforded by the Society's laboratory, and received instruction in certain branches of bacteriology. Dr. Greig-Smith is at present in Europe, on leave, familiarising himself with the recent advances in bacteriological science.

During the past twelve months Mr. H. I. Jensen, Macleay Fellow in Geology, has been continuing his work on the alkaline rocks of Eastern Australia. Early last year he completed the petrological investigation of the specimens collected in the Warrumbungle Mountains during the preceding year. He also visited Queensland to make some final observations in the field prior to the publication of his paper on the Geology of the Volcanic Area of the East Moreton and Wide Bay Districts, Queensland. On this expedition he discovered another area of glaucophane schists to the north of the Conandale Range and west of the Blackall Range in the Mary River valley. In May last year he was granted leave of absence to visit Samoa to study the geological features of the eruption in progress on the island of Savaii. After writing up his paper on Samoa and investigating the rocks collected in the islands, he resumed his work on the Australian alkaline rocks. Mr. Jensen commenced field work in the Nandewar Mountains, starting out from Narrabri; having examined the geology of this district and made a large collection of speci-

mens, he drove across to Coonabarabran and finished his field work and collecting in the Warrumbungles, commenced in the previous year. From the Warrumbungle Mountains he proceeded to Dubbo to examine the alkaline rocks lately discovered there by Mr. Myrton, Geological Surveyor of New South Wales. He returned in the end of November after an absence of nearly three months. Since his return Mr. Jensen has been occupied with the petrological examination of the rocks collected, and is at present making chemical analyses of some of the most interesting types. Amongst the rocks collected were alkaline syenites, alkaline (arfvedsonite) trachytes, ægirine-nepheline phonolites and other alkaline rocks from the Nandewars; and nosean, pseudoleucite, nepheline phonolites, alkaline trachytes and pantellarites, sodalite and melilite basalts, &c., from the Warrumbungles. There is also a remarkable porphyritic sill rock from the Nandewars which may perhaps form a new rock-type. Mr. Jensen expects to have a paper ready by June or July, embracing all his work in the field and laboratory on the Geology of the Nandewars and Warrumbungle Mountains. I may add that the Council has reappointed Mr. Jensen to a Fellowship.

In response to the Council's offer of two vacant Linnean Macleay Fellowships two applications were received, one of which met with the approval of the Council. I have now much pleasure in availing myself of the first opportunity of formally announcing to the Society the name of the second Linnean Macleay Fellow, Mr. James M. Petrie, D.Sc. The particular branch of work which Dr. Petrie will follow is Biochemistry. Dr. Petrie's training has been such as to especially fit him for this line of research. Commencing at the Heriot-Watt Science College, Edinburgh, Dr. Petrie continued his studies at the University of Sydney where he completed a distinguished science course at the end of 1905. Among distinctions gained were first class honours and medal in chemistry at the B.Sc. examination of 1904; Caird Research Scholar in Chemistry (1904); and first class honours and medal in Organic Chemistry at the D.Sc. examination of 1905. Dr. Petrie is highly recommended by his instructors, and has had

valuable experience both as a teacher and as an investigator. His published papers comprise a thesis for the D.Sc. degree, "The Mineral Oil from the Torbanite of New South Wales," published separately (Sydney, 1906) and also in a somewhat abridged form in the Journal of the Society of Chemical Industry, (Vol. xxiv., 1905), and "The Stinging Property of the Giant Nettle-Tree" (*Laportea gigas* Wedd.) in the Society's Proceedings for 1906. Dr. Petrie is now engaged upon important investigations upon the composition of Piturie, and upon the occurrence of strychnine in the native Strychnos tree of New South Wales; and at our last monthly meeting he was able to show a sample and to make a preliminary announcement concerning his isolation of a new midriatic alkaloid from the leaves of *Solandra lævis* Hook., a tropical American solanaceous plant cultivated in gardens. There is a very large and important field of work open for investigation in Australia, in the branch chosen by Dr. Petrie; and we look forward with the greatest interest to the results of his investigations. It is not expected that the volume of work should be great, for if it is to be useful it must be thorough, and thorough work in biochemistry can only be carried on at the expenditure of much time and labour.

The 23rd May ensuing will be the two-hundredth anniversary of the birth of Linnæus, the great Swedish naturalist. The University of Upsala has taken steps to commemorate this interesting event in a manner worthy of the occasion; and has honoured the Society by inviting it to send an official representative to participate in the rejoicings. Our geographical remoteness and the shortness of the interval may possibly prevent the acceptance of the letter of the invitation. But the Council has accepted its spirit by deciding to hold a Special Meeting, in honour of the occasion, on 23rd May, so that, as Members of a Society bearing the name of the illustrious Swede, we may have an opportunity of refreshing our memories upon such points as the salient features of his life, his teaching, and his influence; as well as upon the significance of our name, and the nature of the bond which unites us in a Society bearing that name. Fuller particulars will be announced at the next Meeting.

During the past year there has been more than usual literary activity in scientific circles in Sydney. Several members of the Society, as is well known, have been engaged in the task of bringing out books on special scientific subjects. The first work to make its appearance is that of Mr. D. G. Stead on "The Fishes of Australia," and after a careful examination of the book I can speak in the highest terms of its usefulness and value, and I congratulate him on the success which has attended its publication. I understand that Mr. Stead has been commissioned to bring out a report on the edible oysters of New South Wales, which will deal with the economic as well as the scientific aspect of the subject. Other members who have works in the press are Messrs. Lucas, Froggatt, Rainbow and Waterhouse, and as each is dealing with a subject in which he has special experience, we may look forward to some very valuable additions to Australian scientific literature. Among official publications issued during the year, were the continuation of Mr. Maiden's "Forest Flora," and Mr. North's "Catalogue of Eggs and Nests of Birds breeding in Australia and Tasmania."

The recognition of the value to the community of scientific guidance has, in many instances, in the past been so scanty that it is a pleasure to note a step in the right direction lately taken by the Government, in the appointment of committees of advice to assist the Public Service Board in respect to scientific and professional appointments in the Public Service, and in connection with the State Museums to discuss all matters affecting the scope and control of these institutions. Considering the objects in view, a wise selection has been made of the members constituting the committees, and there can be no doubt that their influence will be most beneficial.

It is with pleasure and satisfaction that, in the name of the Society, I take the first opportunity of officially welcoming back Professor David on his return from attending the great Geological Congress at Mexico and the meeting of the British Association in England, at both of which functions he very worthily upheld the scientific reputation of Australia.

Last year I alluded to the biological exploration of the Blue Lake, Mount Koscuisko, by Professor David and colleagues; and as it has since happened the examination then made was most opportune. A few months after Prof. David's visit, the Council of this Society learned that the Fisheries Department contemplated taking steps to stock the Blue Lake, amongst other inland waters, with introduced trout. The importance of a minute biological survey of undisturbed inland lakes is now thoroughly recognised, as witness the elaborate work being carried out on such in Britain, America and elsewhere, and the Council accordingly approached the Fisheries Board with a view to having the Blue Lake left undisturbed. The Board courteously replied that for the present the proposed introduction of trout would not be carried out. The Fisheries Board will, I am sure, support the efforts of this Society to retain intact some at least of the smaller patches of undisturbed water, for the benefit of science.

In last year's Address mention was made of a grant from the Royal Society of London to Professor Haswell for deep-sea dredging. The first expedition, which was made in June last, met with somewhat disappointing results owing to stormy weather. A second and very successful excursion was carried out in October, the spot dredged being about 35 miles east of Sydney, on the 152nd meridian, in 800 fathoms depth. By the use of the bucket dredge and a small trawl modelled on that recommended by the Prince of Monaco, a varied assortment of most interesting forms was obtained. The organisms secured by tow-netting at the first excursion have in part been already described in the Records of the Australian Museum. Descriptions of the animals procured on the second trip, by various authors, are well advanced and will be published shortly. I am pleased to say that the Royal Society of London and the Australian Association for the Advancement of Science have provided funds for further carrying on of dredging operations, and Admiral Field has placed a well-equipped sounding machine at the disposal of Professor Haswell.

Some Questions in Terrestrial Physics.

In the course of my address last year I dealt with some features of oceanic physics and incidentally with a number of phenomena having an important bearing on the study of certain great geological problems. The facts and speculations which I then placed before you were received with so much favour by members and friends that I have decided on this occasion to discuss a few interesting questions in terrestrial physics which have lately been occupying a prominent position in scientific thought.

Radium and the Earth's Internal Heat.—The very unexpected properties possessed by radium have elevated it to a position of prominence quite out of proportion to the relative extent of its occurrence in the earth's crust. Radium is probably the rarest—as regards quantity obtainable—of any substance so far isolated, and yet, so unique are its characteristics and so far-reaching are the possibilities attaching to its presence, that, though its very existence has only been known for a few years, it is now the subject of more experimental study than any other body. Briefly, the reason why so much interest centres round this substance is that it is considered to be in a state of disintegration, a condition accompanied by a hitherto quite unsuspected display of energy, manifesting itself in most remarkable ways. The study of the properties of radium has disclosed the existence of an enormous store of energy locked up in the constitution of matter, and it is the phenomena accompanying the liberation of this energy during the breaking up or disintegration of radium that render the subject one of such great interest and importance. The conclusion arrived at from careful observations on the rate of decay of radium is that a given unit of this substance has a life which may be stated as roughly about 2000 years. In other words, an ounce or a pound or a ton of radium would, in the course of some such period, no longer possess the peculiar properties of the original substance, and would have lost materially in weight.

Radium is generally supposed to be itself a product of the slow breaking up of uranium and certain other elements. Uranium

compounds spontaneously, and at a definite rate, yield radium, which in turn breaks up, giving rise ultimately as its chief product to the gas helium. This latter substance was first detected spectroscopically in the sun, but is now known to exist in small amount in our atmosphere, in the water and gas emitted by springs, and in a number of minerals.

Opinions as to the precise nature of the phenomenon involved in the disintegration of radium are at the present time somewhat divided. The most generally held view is that we have here to do with a true case of atomic disintegration, the actual breaking up of a chemical element through the disintegration of its atoms, the integrity of which has hitherto been an axiom of chemistry. This is the opinion expressed by such capable observers as the Hon R. J. Strutt, Mr. Soddy and others, and, with some reserve, by Prof Rutherford. On the other hand, it is considered by the veteran Lord Kelvin and by Prof. Armstrong that it may quite well be that the emanations from uranium, and in turn from radium, pre-exist as such, and are simply continually escaping from combination, that, in fact, radium may be merely a compound body liberated from uranium and in turn breaking up explosively. The contention of the latter authorities is that the atomic disintegration theory is not proved and that speculation has gone ahead of observation. This question, however, does not particularly concern the aspect of the subject with which I desire to deal on this occasion, so that its further discussion will not be necessary here.

I have already mentioned that the phenomenon which we have been considering is accompanied by the liberation of a relatively enormous amount of energy, the bulk of which makes itself manifest as heat. Assuming that uranium (or other radium-producing substance) is distributed in sufficient quantity through the earth's crust and that the disintegration phenomena with accompanying liberation of heat go on beneath, as they do at the surface, the production of this heat will have a most important bearing on internal terrestrial temperature, on volcanic activity, and, incidentally, on the great question of geological time.

Without going much into detail, it will suffice to state that different observers have determined with some degree of accuracy the proportion of radium contained in various representative rocks and minerals. The Hon. R. J. Strutt in particular has devoted much attention to this investigation and has found that the proportion varies greatly in different rocks. Acidic rocks such as granite are on the whole richest in radium, while basic ones such as basalt contain least. Minerals rich in uranium and certain other rare elements contain relatively large amounts of radium, the latter bearing in all cases a definite relationship to the uranium present; but these minerals are sparsely distributed and exist in insufficient quantities to materially affect the average composition of the earth's crust as regards radium content. Full details of Mr. Strutt's work on this subject were brought before the Royal Society of London in April, 1906.* The following figures express the proportion of radium existing in a few of the representative rocks examined by Mr. Strutt:—

Rock.	Density.	Radium per gram in grams.	Radium per c.c. in grams.
Granite	2·63	$9{\cdot}56 \times 10^{-12}$	$25{\cdot}2 \times 10^{-12}$
"	2·62	9·35 "	24·5 "
"	2·65	6·63 "	17·6 "
"	2·64	2·45 "	6·47 "
Dolerite	2·95	1·24 "	3·65 "
Basalt	2·75	1·26 "	3·46 "
"	2·80	1·03 "	2·89 "
"	3·01	0·613 "	1·84 "

It is not easy to realise from figures such as the above how minute are the quantities of radium involved; perhaps this may be better done if we consider the largest of these amounts in another way. $9{\cdot}56 \times 10^{-12}$ gram radium per gram rock is equivalent to 9·56 parts in one billion, or about 1 grain in 6000 tons. It is one of the most remarkable features of modern physical methods that it should be possible to estimate such excessively

* See Chemical News xciii., 235 & 247, 25 May and 1 June, 1906.

minute amounts with precision and certainty, amounts not only infinitely beyond the range of chemical detection, but also quite outside the powers of the spectroscope unless the material is first specially concentrated. In a paper on "The Evolution of the Elements," read before the British Association at its last meeting, Mr. F. Soddy remarked :—"The smallest quantity of any element that can be detected by the spectroscope contains 10^{10} individual atoms, whereas the disintegration of a single atom accompanied with the expulsion of one *a* particle is not greatly, if at all, below the limit of detection by present methods."*

The radio-activity method is thus in this case something of the order of 10,000,000,000 times more sensitive than the spectroscopic. The former method depends on the intense ionising power of the emanation, whereby air submitted to its action is brought into a state of partial disintegration known as ionisation, in which condition it becomes an active conductor of electricity. The emanation from a known quantity of radium is collected in air during a fixed period, and the conducting power of the air is then determined by suitable means. The same method applied to any specimen under examination gives the relative value from which its radium content can be readily calculated.

Mr. Strutt considers that 5×10^{-12} gram radium per c.c. rock may be taken as a reasonable average for the rocks constituting the earth's crust. Taking the mean density of the rock at 2·7, this would be equal to $1{\cdot}85 \times 10^{-12}$ gram radium per gram rock.

Assuming the internal heat of the earth to be entirely derived from the disintegration of radium uniformly distributed throughout its mass, and taking Lord Kelvin's data for the thermal conductivity of the rocks *in situ*, Mr. Strutt calculates that the amount of radium necessary to account for the observed heat gradient near the surface is about $0{\cdot}175 \times 10^{-12}$ gram per c.c., an amount greatly less than the smallest proportion found in any igneous rock examined. From this and other data he concludes that radium does not exist in the earth's centre, but is confined

* Chemical News xciv., 86, 24 Aug. 1906.

to a crust not exceeding 45 miles in thickness and that the temperature from that point to the earth's centre is not greater than about 1500°C.(2732°F.).

Mr. O. Fisher has examined the subject more in detail.* Taking the two most commonly accepted values for the temperature gradient of the earth's crust at the surface, that of Prestwich, which is 1°F. for each 42·2 feet of descent, and the more modern one of 60 feet for a similar rise of temperature,† he shows that the amount of radium required is a diminishing quantity downwards, which is expressed in the following table:—

Thickness of crust. Miles.	Gradient 1° F. in 42·2 ft.			Gradient 1° F. in 60 ft.		
	Radium content gram per c.c.	Temp. °C.	do. °F.	Radium content gram per c.c.	Temp. °C.	do. °F.
15	$15{\cdot}39 \times 10^{-13}$	519	966	$10{\cdot}27 \times 10^{-13}$	363	685
20	11·55 ,,	692	1278	8·08 ,,	484	903
25	9·13 ,,	865	1589	6·39 ,,	606	1123
30	7·70 ,,	1038	1900	5·09 ,,	727	1341
35	6·60 ,,	1211	2212	4·62 ,,	848	1558
40	5·77 ,,	1384	2523	3·84 ,,	969	1776
45	5·13 ,,	1557	2834	3·59 ,,	1090	1994

The figures for °F. given by Mr. Fisher are in some cases not in agreement with the °C.; these I have corrected in above table.

Mr. Fisher points out that Professor Bartoli ascertained the temperature of lava flowing from Mount Etna to be 1060°C. (1940°F.), corresponding to a depth of from 30 to 40 miles, according to which of the above temperature gradients is adopted. The 45 miles thickness of crust adopted by Mr. Strutt agrees very well with that arrived at by Professor Milne from a study of the propagation of earthquake waves.

The values for radium content in Mr. Fisher's table come well within the scope of the actual amounts ascertained by Mr. Strutt to exist in accessible rocks.

* Nature. lxxiv., 11 Oct. 1906, p.585.

† In my address, Proc. Linn. Soc. N. S. Wales, 1905, p.618, I took the mean of these, viz., 51 ft. Prof. Gregory, Chem. News xciv., Sept. 21, 1906, p.143, adopts 55 feet.

Lord Kelvin does not acquiesce in the above theory of earth-heat; he considers it highly probable that the conditions of pressure and environment at a short distance from the earth's surface are sufficient to effectually prevent the disintegration of radium and hence the evolution of heat.*

The heat evolution from 1 gram of radium amounts to 0·6785 British thermal units per hour, or 5944 in a year, which is equivalent to the evaporation of 175 lbs. of water per annum by 1 oz. of radium. The mechanical equivalent of the latter may be expressed as being equal to the raising of 577 tons 100 feet above the earth's surface. It is startling to think that this enormous thermal energy is evolved in the time stated with the loss of but a minute fraction of the weight of the radium involved. Professor Rutherford estimates the energy equivalent of radium as at least a million times that of any other known molecular combination.†

As the most moderate estimate of the quantity of radium in the rocks constituting the earth's crust is amply sufficient to account for the observed heat gradient near the surface, if what I might call the extreme radium theory be accepted as accounting for the present thermal condition of the earth, it becomes necessary to abandon the idea of there being any serious quantity of the original gravitational heat remaining. It is the essence of the extreme radium hypothesis that a condition of thermal equilibrium has been attained, that the earth is neither getting hotter nor cooler and will remain in its present condition so long as the production of radium continues at an adequate rate. That there must be a time limit is obvious, for the supply of uranium or other radium-yielding material cannot be inexhaustible, but considering the enormous energy equivalent of radium, we see that exceedingly small proportions are adequate to yield the required heat for a very long period. The possible extension of time is enormously increased if a recent suggestion of Prof. J. Joly be

* Chem. News. xciv., 21 Sept. 1906, p.145.

† Rutherford, "Radio-Activity," 2nd ed., p.482.

accepted that the earth may be continuously deriving its supplies of radium from solar emanations.* It is known that the tangential speed of projection of the matter constituting the solar emanations is sufficiently great to carry it out of control of the sun's gravity and into the sphere of influence of the earth. Prof. Joly thinks that this might account for the apparent limitation of radium to the crustal skin of the earth. That other bodies yield analogous disintegration products, accompanied by the evolution of energy, is well ascertained, but in no known case is this activity at all comparable with that of the uranium-radium product. Still, however, it is quite in keeping with modern views that all matter is in a more or less rapid condition of disintegration, and we cannot say how much of the heat of the earth's interior may be due to the aggregate effect of disintegration and transformation in the mass of matter of which it is composed. I mentioned Sir William Crookes' views on this phase of the subject in my address last year.† Possibly the earth's supply of radium-producing elements may be fairly evenly distributed throughout its mass, and disintegration, while not altogether prevented, may be greatly curtailed by environment and pressure. Were this so we might expect a considerably augmented radium production when materials from beneath reach the surface through the agency of volcanic action. This would account for the surface material displaying so much greater radium activity than can possibly be the case throughout the interior of the earth. At the same time such a conception of the place of radium in the scheme of world physics permits of the possible, and, for my part I think, highly probable, retention by the earth of a portion of its original gravitational heat. We should then have a cooling globe masked by a heat-generating crust, the effect of which would be to indefinitely delay the secular cooling of the heated centre.

Assuming the heat of the earth's central mass to be due to the original store of gravitational heat, Lord Kelvin has shown that

* Nature, lxxv., 1907, p.294.

† Proc. Linn. Soc. New South Wales, 1905, p.617.

in order to account for the existing heat gradient near the surface an internal temperature of about 7000° F. is required.* This is much higher than the temperatures calculated by Messrs. Strutt and Fisher as being adequate if the central heat is derived from radium contained in the crust. In the one case we have a hot centre cooling outwards, in the other a warm crust also radiating heat outwards, but maintaining its thermal equilibrium by the production of heat from radium. The temperature difference between the two conditions, for the central mass, is a physical necessity, and the estimation of its approximate amount is simply a matter of calculation.

For our present purpose it does not matter whether we adhere to the nebular hypothesis, which, since its enunciation by Laplace and subsequent elucidation by later mathematicians, and notably by Lord Kelvin, has been practically universally accepted, or adopt the accretion theory brought forward by Professor G. H. Darwin in his Presidential Address to the British Association in 1905. According to the latter theory, the earth was built up by the gathering of pre-existing planetoids from its orbital region in space. Either theory is competent to provide ample heat, which is all that is required in our present discussion. In the remainder of this address I will speak of the original heat of the earth merely as gravitational. The planetoids are commonly held to have to a large extent originated from the gravitational disruption of former celestial bodies through these approaching within critical range of one another. This supposition has the merit, against the collision theory, of better explaining the structure of stony and other meteorites, which could not have resisted the inevitable fusion, or even vaporisation, following actual collision.

Professor T. C. Chamberlin, of Chicago, has worked out a very ingenious development of the accretion theory which is full of extremely suggestive ideas, but seems to me to be less convincing

* Kelvin, Popular Lectures and Addresses, Vol. ii. 1894, p. 313. See also these Proceedings, 1905, p. 619.

than the simpler hypothesis of Professor Darwin.* According to Professor Chamberlin, the accretion of planetoids was in all probability a slow process, so much so that the heat of impact was dissipated about as rapidly as acquired. Hence, he concludes, conditions suitable for the establishment of life may have existed when the earth was but a fraction of its present size. The existence of central high temperature he attributes in part to a remnant of gravitational heat acquired through the primary nucleus having been gathered rapidly when planetoids were relatively abundant, but in the main to the gradual increase in pressure as the globe increased in size. Mere pressure does not produce heat unless it causes change of volume, and it seems doubtful to me that the denser packing and molecular rearrangement through increase in pressure, which Professor Chamberlin assumes, could be sufficient to generate the heat required. He, however, expressly states his conviction of the sufficiency of the cause given, and concludes that the present internal temperature of the earth increases steadily to the centre, which he estimates to be about 20,000°C.(about 36,000° F.). It will be seen that this temperature is greatly in excess of the 7,000° F which Lord Kelvin considers possible for the present surface thermal gradient if due to a cooling hot centre, and still more in excess of the modest 2,700° F. required by Mr. Strutt for a radium-warmed globe.

It is further not at all clear to me how under the conditions postulated by Professor Chamberlin the lunar satellite could come into existence. Professor Darwin concludes that the heat of impact of the planetoids was great enough to cause incandescence of the entire mass of the growing earth, and, as the result of a careful mathematical examination of the problem of a revolving molten mass such as is assumed for the early condition of the earth, finds that the shape acquired will vary with the rate of revolution. At one particular speed it will be of the earth's present shape; at a higher speed the equatorial outline will be an

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* Chamberlin & Salisbury, Geology, Vol.ii. 91, 1906.

oval like an egg spinning on its side; at a still higher speed one end will form a projection which will take the form of a neck with a drop at its outer extremity, and, ultimately, this will be thrown off to form a satellite revolving around the parent body. The beauty and suggestiveness of this scheme become all the greater when we reflect that under such circumstances the original mass must, through the tidal action induced by its own offspring, continually decline in its rate of revolution, and assume a shape corresponding to its changed speed, while the satellite will, through reflex action, steadily increase its distance from the parent body.

Although we are accustomed to speak of the earth as being practically a rigid body, we must not lose sight of the fact that it is so merely in a comparative sense, and that the hardest rocks of its crust are sufficiently plastic to permit of the shape of the whole accommodating itself to any change in speed of rotation or indeed to any adequate force continuously applied. The existing equatorial bulge is the result of a definite force due to the period of revolution, and will certainly alter in unison with the gradual decline in the rate of that motion. Could the revolution of the earth be stopped without disruption through inertia, the equatorial bulge would disappear in obedience to gravity, and the earth would become practically globular in shape.

As will be obvious to all, the extreme interest and importance of the development of the radium hypothesis lies in the great extension of time which it permits for biological evolution and geological development. When we limit the habitable age of the earth by the possible time allowable for cooling from its original heated state, very grave difficulties arise as to the possibility of fitting in the requirements of geological time; but in the light of the possibilities of radium it is easy to push back the period of gravitational incandescence until the time occupied in cooling from that condition to one in which the existence of life is possible, becomes but a small fraction of the earth's history. There are, of course, astronomical reasons for placing a limit on the earth's age, but the requirements of astronomy permit of a

liberal allotment of time, and there is no reason for limiting the original supply of radium-producing material, and, hence, of the time during which its heat has been available.

It is quite obvious that in the earlier stages of the earth's history, when rapid cooling was taking place, crust movements on a colossal scale must have occurred, and that as cooling proceeded, these would gradually moderate. If we imagine a time when all this heat had disappeared and the earth had arrived at a stage of thermal equilibrium such as is assumed under the extreme radium theory to be its existing condition, it is evident that no more shrinkage could take place and that any display of crust movement or volcanic energy must be due to some other cause. The material of the earth's interior up to a point comparatively near the surface, is, as we know, at a temperature considerably above its surface melting point, but there is evidence that it is retained in a solid state by the pressure of the supernatant strata. Whenever this pressure is relieved liquefaction occurs, and we then have the fused matter squeezed out in the form of lava, through any available opening; or, it may be, forming sheets or dykes at or beneath the surface. We may consider any given land area as floating on a substratum of lava, which, though solid, or perhaps more or less plastic, is ready to respond to relaxation of pressure. It is thoroughly well understood that the surface of the land, and, in particular, the great mountain masses, lose in the aggregate very large quantities of material every year through denudation. The removal of such quantities of matter from one place to another on the earth's surface must have a very considerable effect on regional stability, and will be quite competent to account for extensive earthquake and other movements. When a land surface is stripped by denudation and the material so removed deposited around it, while the pressure of the surface in question is lessened, that of the area receiving the spoil is increased, and the effective force operating in the direction of raising the one area and depressing the other will, in an ideal case, be double the weight of the transferred material.

There appears to me to be much difficulty in accounting for the various observed land movements if these are to be attributed to denudation alone, but if to this source of disturbance be added a moderate amount of shrinkage through secular cooling, all classes of earth movement, folding, &c., can be much better explained. From shrink ge alone, one would expect erratic tilting and sinking, but not orderly regional uplifting or subsidence, and it seems probable that such movements are in the main due to denudation. Land may readily enough sink through denudation in spite of the attendnt removal of pressure, because that very relief may bring about the liquefaction of lava previously held solid by pressure, while the accompanying disturbance opens up channels for its escape.

It has during recent years been increasingly manifest that much volcanic activity is caused by the penetration of ocean water through earthquake fissures to the interior hot part of the earth, with the consequent production of steam at very high tension. Large quantities of hydrogen chloride are at times emitted by volcanoes, and, it being now pretty well known that existing plutonic waters are practically free from chlorine, the obvious source of supply of this substance is the salt of the ocean water.*

It has been suggested that if the crust of the earth contains sufficient radium to provide the heat known to exist in the interior, the moon, from its supposed mode of origin, must also be equally rich in radium, and should indeed have an even greater internal heat than the earth. This question has been very satisfactorily dealt with from the extreme radium standpoint by the Hon. Mr. Strutt,† who points out that though the period of lunar volcanic activity has been generally believed to be past, much doubt has been thrown on this assumption by the observations of modern astronomers, and notably by Professor W. H. Pickering, who is decidedly of the opinion that changes sufficiently great to be noted occur from time to time on the moon's surface. That

* See references, Proc. Linn. Soc. N. S. Wales, 1905, p.621.

† Proc. Roy. Soc. London, A lxxvii. 472.

these changes are not more commensurate with the probable internal heat, may well be because of the absence of water. If it be the case that terrestrial volcanic action is largely induced through atmospheric denudation and oceanic penetration, then the absence of water and of atmosphere from the moon would sufficiently account for her comparative surface stability, and if to the original gravitational heat be added radium blanketing, then, as in the case of the earth, we can readily admit a prolonged condition of internal high temperature, and the absence of any serious amount of disturbance from shrinkage due to secular cooling.

If the presence of radium is admitted as a factor in the thermal evolution of earth and moon, it is but a natural step to apply the same reasoning to the sun and thereby to open up a vista of time for the entire solar system greatly in excess of anything hitherto considered by physicists to be admissible.

Carbon Dioxide and Geological Climate.—For some years past a good deal of attention has been devoted to the question of the influence on climate of possible variations in the composition of the atmosphere as regards its carbon dioxide and moisture contents, and more especially on the competency of such variations to induce the great climatic changes which are involved in the transition from conditions even warmer than those which are now experienced in temperate regions, to a state of glaciation sufficiently severe to partially invade the tropics. I propose to outline the principles underlying this problem and to show in what manner the effect described might be brought about by the specified changes in atmospheric constitution. In all that follows regarding the carbon dioxide theory of glaciation, I do not wish to be understood as entirely indorsing all the details given. The hypothesis seems to me a very beautiful and suggestive one, and my desire is to give, as far as I am able, a concise account of its salient features, leaving my hearers to form their own opinions as to its adequacy as a cause of the observed phenomena. Professor Chamberlin has elaborated this hypothesis in a series of extremely valuable papers full of

luminous suggestion, which should receive the most careful study from all interested in the great questions of earth history, and to which I am much indebted.*

The idea that glaciation over a wide range of the earth's surface could be caused by removal of carbon dioxide and concurrently of water vapour from the atmosphere, is by no means novel. It appears to have been first suggested by Professor Tyndall, who was led thereto by the result of his observations on the thermal properties of gases and vapours. Tyndall found that while simple gases such as nitrogen and oxygen, which constitute the bulk of the existing atmosphere, are extremely transparent to the entire solar emanation of light and heat, compound gases like carbon dioxide, marsh gas, ammonia, &c., and the vapours of water, alcohol, essential oils, &c., differentiate between the various wave lengths, and, while allowing some to pass as freely as do the simple gases, offer greater resistance to the passage of others. The waves which are unable to pass through the compound gases and vapours are the long obscure ones in the ultra-red, while the shorter waves above this pass freely. Even in very moderate thickness such gases are able to effectually bar the progress of considerable quantities of obscure heat.

As a matter of fact no sharp distinction can be drawn between heat and light, the waves of the former passing insensibly into the latter as we progress along the spectrum. Light waves differ from one another and from those of heat merely in their length, and, as all progress through space at equal rates, it follows that the shorter waves give a greater number of impacts to a receiving surface in unit time, than do the longer. The longest waves, giving the fewest impacts in unit time, are the obscure heat rays of the ultra-red, and as we pass on towards the visible spectrum the waves become shorter and shorter, and constitute what is commonly called radiant heat.

Professor Tyndall was the first to put the matter of the selective action of gases upon radiant energy on a proper foundation, and

* Jour. Geol. Vols. v. and vii., 1897 and 1899.

the results of his classic researches, as detailed in his published lectures, may still be considered as the clearest and most illuminating account of the phenomenon in question.* The cause of this difference in behaviour of the two kinds of gases lies in the fact that the simple gases do not respond to the vibrations of the portion of the spectrum carrying the heat waves; they behave to these much as they do to the still shorter waves of visible light: while on the other hand, the larger molecules constituting the compound gases, while quite as transparent to the light waves as those of the simple gases, are capable of vibrating in unison with the obscure heat waves, and so, by transferring the energy of these to themselves, offer an effectual barrier to their progress. The action of the compound gases towards obscure heat rays is much the same in character as that of a sheet of metal when placed so as to intercept the heat from a fire; the metal is capable of responding to the vibrations of the heat waves, and so absorbs their energy to produce heat vibration in its own substance.

We may now very briefly consider a very interesting phenomenon, the acceleration or retardation of the waves of radiant energy when the body emitting them is moving in a direction to or from the observer. A very commonly noticed analogous case is the sharpening or flattening of the pitch of a railway whistle when approaching or receding. If the source from which the radiant energy is being emitted be approaching the observer, the waves right along the spectrum are accelerated by the precise amount of the forward motion, while the radiation from a receding body will be drawn out or retarded. A ray from a stationary body, which reaches the eye as yellow, will, from a body approaching at a sufficiently rapid rate, be accelerated, and appear as some colour nearer the blue, while from a receding source it will be retarded in the direction of the red. Obviously, any absorption lines in the light from a body moving in the line of sight, will be displaced in one direction or another, according

* Tyndall, "Heat a Mode of Motion," 6th ed., 1880, p.321 *et seq.*

to the rate of travel of the body, and thus furnish a means of telling the direction and speed of motion. It is further evident that waves beyond the visible spectrum at one end or the other may be brought into the visible range by acceleration or retardation. So also, rays belonging to the visible red end may be changed into invisible heat, or others at the blue end may be pushed forward and accelerated into invisible chemical rays.

The temperature of a heat-emitting body has a direct influence on the nature of the heat evolved. The hotter the body the more nearly the heat waves approach the properties of red light, while the cooler the body the more they tend to become obscure. All heat given off from a body of the nature of the earth is of the obscure type. Radiant heat is not reflected as such but is degraded and sent away in the lower form.

We may now picture the earth's atmosphere, containing carbon dioxide and water vapour, with the sun's radiant energy pouring into it. The long waves of obscure heat will be absorbed in the upper layers of the atmosphere, leaving the shorter waves of radiant heat to pass on and reach the surface of the earth, where they are at once absorbed, partly by the solid and partly by the aqueous surface. The warmed solid surface proceeds to part with its heat by radiation and contact with the air, the heat emitted being now of the obscure type, and so unable to pass the carbon dioxide and water barrier. The result is that the lower layers of the atmosphere become warmed by the transformed heat which before passed freely through. The fate of the heat taken up by water is mainly to cause evaporation, whereby it is carried in the latent state in the water vapour and liberated where the vapour condenses to form clouds, the ultimate result being, that like that absorbed by the land, it goes to warm the atmosphere. Finally the heat acquired by the atmosphere is scattered in all directions, some back to the earth, some laterally to the surrounding portions of the atmosphere, and some into space. A condition of equilibrium is then established, the earth losing heat at the same rate as it is received, but with the vastly important provision that its own surface remains at a temperature high enough to give what I might term heat pressure suffi-

cient to penetrate the obstructing atmospheric blanket. The less of the efficient heat-trapping carbon dioxide and water vapour are contained in the atmosphere, the lower will be the surface temperature necessary to produce a state of equilibrium, and hence, the colder will be the climate at the earth's surface, and, conversely, the more carbon dioxide and water present in the air, the higher will be the temperature. The carbon dioxide may be considered as the controlling factor in determining the absorptive power of the atmosphere for heat, for, although water vapour has probably a greater actual effect, it depends entirely on temperature for its presence, while carbon dioxide is not directly affected by the temperature changes which it itself induces. When carbon dioxide is removed the temperature falls, and with fall in temperature the proportion of water vapour decreases; such decrease is followed by a further fall in temperature which again robs the atmosphere of more water vapour, and this process goes on until the lowest temperature which the carbon dioxide will permit is reached, and a condition of thermal equilibrium is set up. When carbon dioxide is increased the temperature rises, and with rise of temperature the capacity of the atmosphere for holding water is augmented, and thereby a further rise in temperature is brought about until by alternate action and reaction thermal equilibrium is again established. We thus see that the carbon dioxide is the dominant element, and in what follows I will for the sake of simplicity speak of the temperature changes as if entirely due to carbon dioxide variation.

The greatest step in advance within recent years, in the development of the carbon dioxide hypothesis, is due to Professor Arrhenius, who, as the result of an extremely able and laborious mathematical examination of the problem, has shown that a certain reduction in the proportion of carbon dioxide now present in the atmosphere would, in so far as can be seen, be competent to bring about a sufficient fall in the average temperature at the earth's surface to produce glaciation to latitudes as low as to be well within the tropics.* Arrhenius bases his calculations on

* Arrhenius, Phil. Mag. (Ser. 5), Vol.xli. 1896, p.237.

the work of Professor Langley on the determination of the variations in the amount of heat received from the full moon when at different altitudes above the horizon and thus shining through varying thicknesses of atmosphere.

Professor Chamberlin assumes that even in early Palæozoic times the atmosphere did not materially differ from its present composition, there having always been a conflict between sources of supply and causes of depletion of carbon dioxide. The amount of this constituent in the existing atmosphere varies somewhat in different regions, but may be stated as averaging about 0·03 per cent. by volume. Arrhenius has calculated that a reduction sufficient to bring this down to 0·016 to 0·018 per cent., or the removal of rather more than one half, would suffice to reduce the mean temperature by an amount equivalent to 7 to 9° F., which would mean the extension of glacial conditions to within about 20° on either side of the equator; while an increase of from 2½ to 3 times the present proportion, bringing the carbon dioxide content to 0·075 to 0·090 per cent., would result in an increase of the mean temperature by 14 to 16° F., and give semitropical conditions well within the arctic and antarctic zones. In support of the possibility of such variation in atmospheric carbon dioxide, Arrhenius quotes the opinions of Professor Högben who has published in a Swedish journal* the result of his studies on the probable sources of supply and causes of depletion of this gas to and from the atmosphere. Högben considers that the atmosphere is and has always been continuously supplied with carbon dioxide, amongst other gases, from the earth's interior. Such supplies would be quite independent of surface conditions, and would continue even during periods of extreme glaciation. This is the important point on which the whole theory depends.

That there are large supplies of carbon dioxide available is well known. Examination of numerous volcanic and metamorphic rocks has shown that they contain, on an average, several times their own volume—at atmospheric pressure—of

* Svensk Kemisk Tedskrift, 1894, p. 169.

permanent gas. There is no difficulty at all about proving the presence of this gas in ordinary rock. All that is required is to heat the rock in small fragments in an exhausted flask, when the gas is given off and can be measured and its composition ascertained. The gas is usually contained in minute cavities throughout the body of the rock, and but little of it escapes even on grinding. That it must be under very great pressure is evident from the volume to which it expands when liberated. Sir William Crookes, in his lecture on Diamonds, delivered before the British Association meeting at Kimberley, mentioned that diamonds frequently explode soon after reaching the surface, or on being gently warmed, owing to the pressure exerted by globules of inclosed gas.* Professor Tilden has thrown much light on the quantity and composition of the gases occluded in rocks, in a paper read before the Royal Society some years ago.† His examination covered a large number of examples of granite, schist, gneiss, basalt, &c., in which he found gas varying from 1·3 to 17·8, and averaging about 5 times, the volume of the containing rock. In a general way hydrogen was found to be the most abundant constituent, but carbon dioxide was also invariably present in large proportion. One series of rocks gave the following average figures for the composition of the contained gas :—

Hydrogen ...	52·2
Carbon dioxide ...	34·1
,, monoxide ...	8·4
Marsh Gas ...	3·2
Nitrogen ...	2·1
	100·0

In another and larger series the mean composition was :—

Hydrogen, &c. ...	73·8
Carbon dioxide ...	26·2
	100·0

At this rate it is a simple matter to show by calculation that the rocks within a very moderate distance of the earth's surface contain more gas than would supply several times the volume of the existing atmosphere, and if the entire mass of the earth be

* Chem. News, xcii. 1905, p. 159.
† Chem. News, lxxv. 1897, p. 169.

assumed to contain gaseous matter in the same ratio, sufficient is in existence to form many hundred atmospheres. Carbon dioxide is known to be evolved in immense quantities from volcanoes and to be also extruded from the rock walls in mines, from springs, from the surface soil and from innumerable caves, one of the best known of which, perhaps, is the Grotta del Cane, near Naples, where dogs are rendered insensible and lights extinguished by the layer of gas on the floor of the cave. It seems reasonable to admit that in these we have a sufficient source of supply for what, though aggregating many millions of tons of carbon dioxide annually, is relatively but a small quantity in comparison with the amount existing in the atmosphere at any one time.

The causes of loss of carbon dioxide may be divided into temporary and permanent. Of the former, absorption by the waters of the ocean and fixation by living organisms may be considered the most important. The great cause of permanent loss will be the withdrawal of carbon dioxide through its action in weathering the surface of the land, which is acting continuously wherever moisture and air have access to rocks and soil. In the case of the carbon dioxide taken up by the ocean, we have seen that this source of loss varies in activity with the temperature of the water, and that with rise in temperature the borrowed gas is returned to the atmosphere. By far the greater proportion of the carbon taken up and fixed in the tissues of living organisms is returned to the air again, for the balance of life and death remains unchanged. It is true that in coal deposits great quantities of carbon have been permanently fixed, but even the total of this, on a liberal estimate, amounts to but a tiny fraction of the world's stock, and in any case such fixation could but take its place along with the other sources of permanent removal and merely have effect in delaying the change from one climatic state to another. The carbon fixed in coral, limestone and similar formations aggregates a much greater proportion of the whole than that locked up in coal, but as all of this is derived from the fixed portion of that captured by the ocean, or in some cases by

freshwater lakes, and hence not available for return to the air, the form in which it is stored is of no consequence so far as glacial changes are concerned. It is in the consumption of carbon dioxide in the weathering of rocks that the great primary source of permanent loss lies. The rocks constituting the exposed surface are largely composed of silicates and by the action of carbon dioxide and moisture these are decomposed, the bases combining with the carbon dioxide and ultimately finding their way into the ocean. Practically all the carbon dioxide so fixed may be considered as permanently lost.

We have seen that depletion of atmospheric carbon dioxide induces a cold surface condition while enrichment results in the opposite effect. When the land surface is at work removing carbon dioxide and thereby bringing about cooling, and the ocean, responding to the change, aids in the withdrawal, all the conditions necessary for the inauguration of a glacial epoch are present, and, accordingly, when the rate of removal of carbon dioxide exceeds that of supply, it is only a matter of time for the change to occur. With the advent of an icy covering the land would be effectually shielded from the action of atmospheric carbon dioxide, and the loss through weathering being stopped, or at any rate greatly reduced, a time of steady accumulation would set in, resulting in the dawn of a genial period; the encroachment of ice would be stopped, the line of glaciation driven back towards the poles, and the rocky surface again exposed. On the completion of one cycle there would be a gradual swing in the opposite direction, and so the continued succession of glacial and warm periods, of which we have evidence, would be accounted for.

There are so many modifying influences, such as variation in the relationship of water and land, which would tend in one way or another to affect the rate and intensity of climatic change as well as the time of duration of both conditions, that nothing in the way of regular periodicity is to be expected in glacial epochs, and that there was no such periodicity seems to be the trend of the evidence. Partial retreats and advances of ice, and greatly

varying rates of change have undoubtedly been the rule. At the present time all the indications appear to point to the world's being in the waning stage of a glacial period, so that warmer conditions are now steadily invading the circumpolar regions.

The question naturally arises at this stage, what would be the effect of the escape of internal heat from the earth in aiding the carbon dioxide of the atmosphere to maintain a genial climate. This problem was long ago dealt with by Sir William Thomson (Lord Kelvin), who arrived at the result that, starting with an incandescent globe, "the general climate cannot be sensibly affected by conducted heat at any time more than 10,000 years after the commencement of superficial solidification."* The same authority elsewhere says: "Ten, twenty, thirty times the present rate of augmentation of temperature downwards could not raise the surface temperature of the earth and air in contact with it more than a small fraction of a degree Fahrenheit. The earth might be a globe of white-hot iron covered with a crust of rock 2,000 feet, or there might be an ice-cold temperature everywhere within 50 feet of the surface, yet the climate could not on that account be sensibly different from what it is, or the soil be sensibly more or less genial than it is for the roots of trees or smaller plants."†

The view has been held by some observers that the internal heat of the earth was a sufficient source of warmth to maintain a uniform genial climate over the entire surface of the globe during long periods of geological time, and that the sun's heating influence during these periods was effectually neutralized by impenetrable banks of cloud. The ocean was supposed to be kept warm by contact with the heated earth.‡ Lord Kelvin, as is seen from the above quotations, gives absolutely no support to this theory. Likewise regarding the belief that the rate of cooling of

* Mathematical and Physical Papers, Vol. iii., 1890, p.305.

† Trans. Geol. Soc. Glasgow, Vol. v., Part ii., 1877, p.250. Kelvin, Popular Lectures and Addresses, Vol. ii., 1894, p.297

‡ See, for example, Manson, 'The Evolution of Climates,' The American Geologist, 1898.

the earth's interior is sensibly affected by variations in the amonnt of heat received from the sun, with consequent manifestation of earthquake action due to increased shrinkage, when, through any cause, there is a falling off in the amount of sun heat received. This position seems to me equally untenable. It is well known that the heat of the sun does not affect the temperature of the soil more than a few feet from the surface, and in the light of Lord Kelvin's work, it appears certain that no variation in surface temperature within even far wider range than is now experienced, can have any sensible effect on the rate of transmission of heat outwards from the interior. Were it the case that mere change in surface temperature had any such effect, we should surely have distinct manifestations of differential shrinkage every winter, through the unequal loss of heat following the change of season. To me it seems that unequal loss of heat through winter ruling in one hemisphere while summer was warming the other, would be far more likely to induce earthquake tremors than even a very considerable increase in the rate of heat loss, uniformly distributed.

In coming to a conclusion on this matter, it will, perhaps, be helpful to consider what is the actual amount of heat escaping from the interior of the earth. Taking the recognised values for heat conductivity of the crustal rocks and for heat gradient near the surface, Lord Kelvin has shown that the loss of heat amounts to about 92 horse-power per square kilometre.* This may be stated in another way, which will, perhaps, convey a more distinct impression to the mind. A horse-power is equal to the raising of 33,000 lbs. one foot high per minute, and 92 horse-power per square kilometre is the equivalent of the evaporation of 10½ lbs. of water per square mile of surface per minute. Even allowing a considerable margin of error for assumed mean conductivity and heat gradient, the result would be of the same *order*, and as it stands may thus be taken as

* Trans. Geol. Soc. Glasgow, Vol. iii. Part ii., 1869, p.234. Popular Lectures and Addresses, Vol. ii., 1894, p.116.

fairly representing the actual state of matters. A fluctuation in the outflow of heat of 10 per cent. would be equivalent to 1 lb. more or less water evaporated per square mile per minute. It may be safely said that one active volcano will dispose of more heat in a day than many hundred square miles of earth surface in a year.

That the glaciation of the earth's surface at any period since palæozoic times cannot have been more than partial, is evident, for were this condition to extend over the entire tropical regions there would remain no sanctuary for the higher forms of life, with the result that all plants and animals unable to withstand the rigours of an arctic climate would perish. That this has not been the case is amply proved by the known continuity of highly developed organisms succeeding one another through long geological epochs covering numerous periods of glaciation. Darwin was much impressed with the importance of glacial mutation as explaining the present distribution of Alpine organisms.*

The plants, for example, found in Alpine regions everywhere over the earth's surface, bear a striking resemblance to one another, indeed, identical species may be found in places widely separated by tracts of country having a climate utterly prohibitive of migration for these, Alpine plants being peculiarly intolerant of other than Alpine conditions. The flora of high latitudes is truly Alpine in character, and similar plants are found flourishing on the European Alps and in the regions fringing the Polar Seas. Any change of climate one way or another must have been gradual. If we imagine an era of glaciation spreading towards the tropics, we can see that for long periods the low level areas would have a climate quite suitable for the growth of Alpine types. In fact the lower levels would constitute a haven for the Alpine flora driven from the mountains by perpetual snow and ice, and thus a region for mingling and for migration would be provided. With the gradual return of genial conditions the plants would migrate back to the mountain fastnesses

* Origin of Species, 6th ed., p.330.

while the plains which had been clothed with Alpine forms would once again be peopled with appropriate denizens which had taken refuge in the equatorial zone from the cold conditions ruling everywhere else. By a process such as this we can understand how isolated mountains in various tropical areas could come to possess a common flora. Under suitable conditions of land configuration the zones around the polar regions would form a recruiting ground from whence the plants could spread tropicwards as the climate became suitable for their welfare, and to the same hospitable regions the cold-loving forms would be driven back by the return of warm conditions to the lower latitudes. There are sufficient mountain chains crossing the equatorial region to act as bridges by which transmigration could take place. For the sake of simplicity I have spoken only of plants in the above scheme, but obviously animals would equally share the facilities for migration, though the conditions on isolated mountain fastnesses would inhibit the survival there of animals to a much greater degree than plants; hence the large arctic mammals, land and amphibious, to most of which the proximity of the sea or the range of great land areas is absolutely necessary, would naturally gravitate to the regions where they are now found. Glacial mutations and attendant land and ocean configuration alterations, must at all times have been exceedingly powerful aids towards many of the radical changes in type of the flora and fauna characteristic of the transition from one geological epoch to another.

In taking leave of the honourable position in which you were good enough to place me two years ago, let me tender my heartiest thanks for the generous support and encouragement accorded me at all times at our meetings and in the conduct of the Society's affairs, and once again to ask you to join me in the sentiment

FLOREAT SOCIETAS LINNEANA!

Mr. J. R. Garland, M.A., Hon. Treasurer, presented the balance sheet for the year 1906, duly signed by the Auditors; and he moved that it be received and adopted, which was carried

unanimously. The Society's income for the year ended December 31st, 1906, was £1,013 15s. 7d.; the expenditure £1,017 16s. 11d.; with a credit balance of £78 4s. 7d. from the previous year, leaving a credit balance of £74 3s. 3d. The income of the Bacteriological Department was £544 0s. 2d.; and the expenditure £479 6s. 3d.; with a credit balance of £238 7s. 6d. from the previous year, leaving a credit balance of £303 1s. 5d. In regard to the Macleay Fellowships' Account, the income was £1389 2s. 9d.; and the expenditure £400, leaving a credit balance of £989 2s. 9d. to be carried to Capital Account.

On the motion of the Secretary, seconded by Professor David, a cordial vote of thanks was accorded to Mr. J. R. Garland, M.A., Hon. Treasurer, in recognition of his valuable services in connection with the finances of the Society; and also to the Hon. Auditors, Messrs. Duncan Carson and E. G. W. Palmer, for their helpful co-operation in carrying out the annual audit.

No nominations of other Candidates having been received, the President declared the following elections for the current Session to have been duly made:—

President: A. H. S. Lucas, M.A., B.Sc.

Members of Council (to fill six vacancies): R. H. Cambage, F.L.S., J. H. Campbell, H. G. Chapman, M.D., B.S., T. Storie Dixson, M.B., Ch.M., Alex. G. Hamilton, Prof. J. T. Wilson, M.B., Ch.M.

Auditors: Messrs. Duncan Carson and Edward G. W. Palmer, J.P.

On the conclusion of the formal business of the Meeting, a very hearty vote of thanks to the retiring President for his interesting address and for his untiring efforts to promote the Society's well-being was carried by acclamation, on the motion of Dr. Woolnough.

The Linnean Society of New South Wales.

GENERAL ACCOUNT.

Balance Sheet at 31st December, 1906.

Liabilities.

	£	s.	d.
Capital: Amount received from Sir William Macleay during his life-time	14,000	0	0
Further Sum bequeathed by his Will £6,000, less Probate Duty, £300 ...	5,700	0	0
	£19,700	0	0
Income Account at 31st Dec., 1906 ...	74	3	3
	£19,774	3	3

Assets.

	£	s.	d.	£	s.	d.
Investments: Loans on Mortgage	17,700	0	0			
Fixed Deposit Commercial Banking Co. of Sydney	2,000	0	0			
				19,700	0	0
Cash: At Bank—Current Account	73	3	3			
In hands of Secretary ..	1	0	0			
				74	3	3
				£19,774	3	3

INCOME ACCOUNT, year ended 31st December, 1906.

Dr.

	£	s.	d.	£	s.	d.
To Salaries and Wages ...				478	0	0
,, Printing (Publications) ...	274	6	1			
,, Illustrations	94	2	8	368	8	9
				2	0	0
,, Library	64	0	0			
,, Ground Rent	19	9	11			
,, Rates	8	2	7			
,, Insurance						
	91	12	6			
Less charged to Bacteriology Account	21	5	0			
				70	7	6
,, Painting and Repairs ...				40	2	3
,, Bank Charges	1	6	5			
,, Postage, Telegrams, Advertising, and Petties ...	44	2	3			
,, Telephone Rent	9	0	0			
,, Printing (sundries), Stationery, &c....	4	9	9	58	18	5
				1,017	16	11
,, Balance to next year ...				74	3	3
				£1,092	0	2

Cr.

	£	s.	d.	£	s.	d.
By Balance at 31st Dec., 1905				78	4	7
,, Subscriptions—						
1905—£19 16 0						
1906— 96 12 0						
1907— 6 6 0	122	14	0			
,, Entrance Fees—						
1906— £3 3 0						
1907— 1 1 0	4	4	0			
,, Interest on Investments ...	763	17	6			
,, Sales (including 100 copies of Proceedings purchased by Government)... ...	123	0	1			
				1,013	15	7
				£1,092	0	2

BACTERIOLOGY ACCOUNT.

Balance Sheet at 31st December, 1906.

Liabilities.	£	s.	d.
Capital: Amount bequeathed by Sir William Macleay, £12,000, less Probate Duty £600	11,400	0	0
Accumulated Interest ordered by Council to be added to Capital	900	0	0
Further Amount ordered by Council to be added to Capital	700	0	0
Interest invested	350	0	0
	13,350	0	0
Income Account at 31st December, 1906	303	1	5
	£13,653	1	5

Assets.	£	s.	d.	£	s.	d.
Investments: Loan on Mortgage	12,300	0	0			
Inscribed Funded Stock at 4%. due 9th August, 1907	1,050	0	0			
				13,350	0	0
Cash in Bank, Current Account				303	1	5
				£13,653	1	5

INCOME ACCOUNT, year ended 31st December, 1906.

Dr.	£	s.	d.	£	s.	d.
To Salary and Wages	426	0	0			
,, Journals and Printing ...	12	2	0			
,, Apparatus and Chemicals...	1	0	3			
,, Petty Cash (Bacteriologist)	13	13	9			
,, Gas	4	8	10			
,, Insurance	0	16	5			
,, One-fourth of Ground Rent, Rates, and Insurance on Hall	21	5	0			
				479	6	3
,, Balance to next year ...				303	1	5
				£782	7	8

Cr.		£	s.	d.	£	s.	d.
By Balance at 31st Dec., 1905 ...					238	7	6
,, Interest on Investments ...		533	19	8			
,, Tuition Fees ...	£30 0 0						
Less Bacteriologist's proportion ...	20 0 0						
		10	0	0			
,, Bank Exchange		0	0	6			
					544	0	2
					£782	7	8

LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT.
Balance Sheet at 31st December, 1906.

LIABILITIES.

	£	s.	d.	£	s.	d.
Capital: Amount bequeathed by Sir William Macleay, £35,000, less £1,750 Probate Duty				33,250	0	0
Balance from Income Account capitalised in terms of bequest						
On 31st Dec., 1904	£1,020	9	9			
On 31st Dec., 1905	1,048	18	6			
On 31st Dec , 1906	989	2	9			
				3,058	11	0
				£36,308	11	0

ASSETS.

	£	s.	d.	£	s.	d.
Investments: Inscribed Funded Stock at 4% due Aug., 1907	34,270	0	0			
Fixed Deposit, Commercial Banking Co. of Sydney ...	1,049	0	0			
				35,319	0	0
Cash in Bank, Current Account				989	11	0
				£36,308	11	0

Dr. INCOME ACCOUNT, year ended 31st December, 1906. Cr.

	£	s.	d.
To Salary of Linnean Macleay Fellow ...	400	0	0
,, Amount transferred to Capital Account	989	2	9
	£1,389	2	9

	£	s.	d.
By Interest on Investments	1,389	2	9
	£1,389	2	9

Audited and found correct, and Securities produced to us.

DUNCAN CARSON
E. G. W. PALMER } Auditors.

12th March, 1907.

J. R. GARLAND, Hon. Treasurer.

WEDNESDAY, MARCH 27TH, 1907.

ORDINARY MONTHLY MEETING.

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

Mr. Thomas McDonough, 15 Waverley Street, Sydney, was elected an Ordinary Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (November 28th, 1906), amounting to 35 Vols, 231 Parts or Nos., 53 Bulletins, 19 Reports, and 72 Pamphlets, received from 121 Societies, &c., and 7 Individuals, were laid upon the table.

DESCRIPTIONS OF AUSTRALASIAN MICRO-LEPIDOPTERA.

BY E. MEYRICK, B.A., F.R.S., CORRESPONDING MEMBER.

XIX. PLUTELLIDÆ.

I have recently examined much material of this group from the Oriental region, where it seems to be rather more prominently developed than elsewhere, and at present I give the family *Plutellidæ* a more extended application than I did in my Handbook of British Lepidoptera. There it consisted of the groups of *Yponomeuta*, *Glyphipteryx*, and *Plutella*; to these I now add the groups of *Gracilaria* and *Zelleria*, which I formerly included in the *Tineidæ*. To explain this change I may say that I now assign more importance to the smooth posterior tibiæ which are a normal attribute of those two groups, than to the rough head which is a frequent characteristic. Moreover, whilst folded maxillary palpi are peculiarly characteristic of the *Tineidæ*, the simple porrected maxillary palpi of the *Gracilaria* group are so similar to those of the *Plutella* group, and so different from those of any other *Tineina*, that they would seem to indicate real affinity. I regard then the *Gracilaria* group as being a narrow-winged modification of the *Plutella* group (with the peculiar larval character of an absence of prolegs on segment 10); and the *Zelleria* group as a narrow-winged modification of the *Yponomeuta* group. The habit of *Zelleria* and its allies of resting on their heads with the hindpart raised is probably imitative of birds' droppings. The reversed habit of *Gracilaria* and its allies of sitting on their tails, so to speak, with the fore-parts raised, was doubtless acquired to display the peculiar thickened and decorated anterior and middle legs (for which I can conjecture no other object than sexual display), and seems to have been

rather difficult to lose when once acquired, as some species which have found it necessary to rest appressed to the tree-trunks for purposes of concealment are constrained to spread these legs out awkwardly at the sides.

The family as thus constituted includes forms of such diverse superficial appearance that it is not surprising to find some reluctance to accept it as a homogeneous group; but I am nevertheless satisfied that it is natural, and am unable to find any characters for breaking it up. It is a primitive group as compared with the other families of the *Tineina*, which are more specialised and have acquired more constancy in certain particulars. Thus in the *Gelechiadæ*, *Oecophoridæ*, and *Xyloryctidæ* veins 7 and 8 of the forewings are invariably stalked (or coincident), never separate; whilst in the *Plutellidæ* this character fluctuates so much in closely allied forms that I am satisfied it is insufficient by itself even to delimit genera. The smooth posterior tibiæ are not constant in the *Plutellidæ*, though very characteristic, and seldom found in any of the other families; there are undoubted Plutellid genera which have the tibiæ more or less rough-scaled or set with thin bristly hairs, or even exceptionally clothed with long fine hairs (as *Piestoceros*, which can hardly be referred elsewhere, though it might possibly belong to the *Tineidæ*). The head is normally smooth, but sometimes rough or even tufted. The veins may be regarded as normally all separate in both wings, though many exceptions occur. Some genera are remarkable for the relatively extremely short cilia of the hindwings, reduced to $\frac{1}{8}$ of the breadth of the wing or even less, whilst in other *Tineina* they are very rarely less than $\frac{1}{4}$. In view of the inconstancy of single characters in this family the combination of leading characters should always be considered to determine the true affinity of a genus.

As many of the genera have been treated already, I have not thought it necessary to repeat descriptions where a genus or species has already been sufficiently described. *Zelleria* and its allies were included in my paper on *Tineidæ*, and the *Gracilaria* and *Glyphipteryx* groups in separate early papers; *Imma* is fully

discussed in a recent paper in the Transactions of the Entomological Society of London. I have included with the Australian species all the material known to me from the Australasian region, *i.e.*, New Guinea and the adjoining islands, and the islands of the South Pacific (excluding New Zealand); and have therefore altered the title of this series of papers from Australian to Australasian.

1. Posterior tibiæ in ♂ elongate, enlarged, longer than tarsi	10. MACARANGELA.
Posterior tibiæ in ♂ normal	2.
2. Forewings with vein 7 to costa	3.
Forewings with vein 7 to apex or termen	18.
3. Forewings with vein 8 absent	4.
Forewings with vein 8 present	6.
4. Forewings with vein 3 absent	5.
Forewings with vein 3 present	40. METAPHRASTIS.
5. Crown roughly tufted	1. LITHOCOLLETIS.
Crown with appressed scales	9. OPSICLINES.
6. Forewings with 8 and 9 stalked	17. THYRIDECTIS.
Forewings with 8 and 9 separate	7.
7. Forewings with 7 and 8 separate	8.
Forewings with 7 and 8 stalked	16.
8. Hindwings lanceolate or linear-lanceolate	9.
Hindwings elongate-ovate	15.
9. Head rough on crown	10.
Head smooth	12.
10. Forewings with vein 3 absent	11.
Forewings with vein 3 present	8. TIMODORA.
11. Face shortly rough-haired, palpi tufted	2. ARISTAEA.
Face smooth, palpi not tufted	3. EPICEPHALA.
12. Posterior tibiæ with bristly hairs above	13.
Posterior tibiæ smooth-scaled	14.
13. Middle tibiæ elongated and thickened with scales	5. CYPHOSTICHA.
Middle tibiæ normal	4. CONOPOMORPHA.
14. Middle tibiæ thickened with rough scales beneath	7. GRACILARIA.
Middle tibiæ not thickened with rough scales...	6. MACAROSTOLA.
15. Basal joint of antennæ with dense flap of scales	42. PHALANGITIS.
Basal joint of antennæ without scale-flap	19. CORYPTILUM.
16. Hindwings with 6 and 7 stalked	17.
Hindwings with 6 and 7 separate	43. AMPHITHERA.

17.	Hindwings with 4 absent	45. PARAPHYLLIS.
	Hindwings with 4 present	46. COPIDORIS.
18.	Antennæ longer than forewings	19.
	Antennæ not longer than forewings	21.
19.	Forewings with 9 and 10 absent	20. TONZA.
	Forewings with 9 and 10 present	20.
20.	Palpi rather long, tufted	12. XYROSARIS.
	Palpi short, filiform	22. EPICROESA.
21.	Hindwings with 4 absent	22.
	Hindwings with 4 present	24.
22.	Hindwings lanceolate	11. ZELLERIA.
	Hindwings elongate-ovate	23.
23.	Hindwings with transparent subbasal patch.	16. YPONOMEUTA.
	Hindwings without such patch	15. PRAYS.
24.	Antennæ strongly compressed, flat	28. PIESTOCEROS.
	Antennæ not flattened	25.
25.	Labial palpi minute	26.
	Labial palpi moderate or long	27.
26.	Forewings with 8 absent	27. CEBYSA.
	Forewings with 8 present	13. CYCLOTORNA.
27.	Antennæ thickened with scales towards base	28.
	Antennæ not thickened with scales	31.
28.	Forewings with 7 and 8 stalked	29.
	Forewings with 7 and 8 separate	30.
29.	Hindwings with 6 and 7 connate or stalked	39. PSEUDAEGERIA.
	Hindwings with 6 and 7 parallel	38. SNELLENIA.
30.	Forewings with 2 from towards angle of cell	25. ANAPHANTIS.
	Forewings with 2 from $\frac{2}{3}$ of cell	30. TORTYRA.
31.	Hindwings with 6 and 7 stalked or coincident	32.
	Hindwings with 6 and 7 separate	35.
32.	Hindwings with 3 and 4 connate or stalked	33.
	Hindwings with 3 and 4 separate	32. IMMA.
33.	Forewings with 7-10 stalked	33. LOXOTROCHIS.
	Forewings with 9 and 10 separate	34.
34.	Forewings with 2 and 3 stalked	24. EREMOTHYRIS.
	Forewings with 2 and 3 widely remote	26. HILAROGRAPHA.
35.	Antennæ in ♂ unipectinated	31. MISCERA.
	Antennæ in ♂ not unipectinated	36.
36.	Antennæ in ♂ ciliated with long fascicles	37.
	Antennæ in ♂ at most shortly ciliated	39.
37.	Second joint of palpi tufted with short projecting hairs	35. CHOREUTIS.
	Second joint of palpi not tufted	38.

38. Terminal joint of palpi obtuse or truncate....... 36. SIMAETHIS.
Terminal joint of palpi pointed.. .... 34. BRENTHIA.
39. Forewings with tufts of scales........................ 47. TRACHYCENTRA.
Forewings without tufts................................ 40.
40. Second joint of labial palpi tufted.................. 41.
Second joint of labial palpi not tufted............ 42.
41. Basal joint of antennæ with dense flap of scales 48. PLUTELLA.
Basal joint of antennæ without flap of scales... 37. GLYPHIPTERYX (part)
42. Hindwings with 3 and 4 remote .... 43.
Hindwings with 3 and 4 connate or stalked..... 46.
43. Hindwings with 4 and 5 stalked.................. 22. LACTURA.
Hindwings with 4 and 5 remote..................... 44.
44. Maxillary palpi developed. .... 41. ORTHENCHES.
Maxillary palpi obsolete... . ... 45.
45. Forewings with 7 to apex............................ 18. ATTEVA.
Forewings with 7 to termen.......................... 23. MIEZA.
46. Maxillary palpi distinct, porrected.. .... 44. DIATHRYPTICA.
Maxillary palpi rudimentary..... .... 47.
47. Terminal joint of palpi short, thick, obtuse..... 14. HOMADAULA.
Terminal joint of palpi moderate, pointed... ... 48.
48. Second joint of palpi with whorls of projecting scales................. .... 37. GLYPHIPTERYX.
Second joint of palpi with appressed scales...... 21. ANTICRATES.

1. LITHOCOLLETIS Hb.

1. *L. stephanota*, n.sp.

♀. 6 mm. Head and thorax whitish-golden. Palpi and antennæ whitish. Abdomen ochreous-whitish, suffused with grey above. Forewings lanceolate; pale shining golden-ochreous; a short white median streak from base; three narrow somewhat curved slightly oblique white fasciæ, second and third edged anteriorly with scattered black scales; a white costal dot before apex, followed by some scattered black scales at apex and on upper part of termen : cilia pale shining golden, with white spot on costal dot. Hindwings rather dark grey; cilia grey.

Sydney, New South Wales, in August; one specimen.

2. *L. aglaozona* Meyr.

(*Lithocolletis aglaozona* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 199.)

Sydney, New South Wales, in November and March. Larva mining leaves of *Desmodium* and *Kennedya rubicunda.*

3. *L. desmochrysa* Low.

(*Lithocolletis desmochrysa* Low., Proc. Linn. Soc. N. S. Wales, 1897, 23; *Nepticula nigricansella* Tepper, Trans. Roy. Soc. S. Austr. 1899, 280.)

Broken Hill, New South Wales; Adelaide, South Australia; in March. Larva mining leaves of *Hardenbergia ovata.*

2. Aristaea, n.g.

Head loosely rough-haired; tongue developed; ocelli present. Antennæ 1, in ♂ filiform, simple, basal joint moderately elongate, without pecten. Labial palpi long, ascending, second joint anteriorly with long rough projecting scales, terminal joint as long as second, pointed, anteriorly with rough projecting scales diminishing to apex. Maxillary palpi moderate, filiform, porrected. Posterior tibiæ smooth-scaled. Forewings with 1*b* simple, 2 from angle, 3 absent, 7 to costa, 11 from middle. Hindwings $\frac{1}{3}$, lanceolate, cilia 2; 3 absent, transverse vein absent between 4 and 5, 5 and 6 stalked.

Differs from *Ornix* and *Epicephala* in having the face shortly rough-haired, as well as the crown, and also in the long rough projecting scales of palpi; in facies it is also quite distinct, and may perhaps be on the ancestral line of *Lithocolletis.*

4. *A. periphanes,* n.sp.

♂. 14 mm. Head white, lower part of face brownish. Palpi white, second joint with brown subapical band. Antennæ grey, faintly ringed with whitish. Thorax brownish, with two white stripes. Abdomen fuscous, towards base and apex pale ochreous. Legs brownish-ochreous, anterior tibiæ and tarsi dark fuscous, middle and posterior tibiæ suffused with dark fuscous towards

apex, tarsi mostly suffused with whitish. Forewings elongate-lanceolate; white; markings ochreous-brown, with a few dark fuscous scales on margins; a suffused streak along basal fourth of costa; a small subdorsal spot towards base; a slightly oblique transverse spot from dorsum before middle, reaching half across wing; an angulated median fascia; two wedge-shaped marks from costa beyond this, and a suffused spot on tornus; an apical spot, including a white dot anteriorly and a black apical dot: cilia brownish suffusedly barred with white, round apex with a dark fuscous median line. Hindwings rather dark grey; cilia light ochreous-grey.

Mount Wellington, Tasmania, at 3000 feet, in December; one specimen.

3. EPICEPHALA Meyr.

Vein 8 of forewings is present (in original description erroneously stated to be absent); posterior tibiæ bristly above. The latter character distinguishes the genus from *Ornix*, which also generally has 6 and 7 of forewings stalked.

5. *E. colymbetella* Meyr.

(*Epicephala colymbetella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 169.)

Brisbane, Queensland; Sydney, New South Wales; from September to January. Larva in seed-capsules of (?).

6. E. *trigonophora* Turn.

(*Ornix trigonophora* Turn., Trans. Roy. Soc. S. Austr. 1900, 21).

Mount Tambourine, Queensland, in November.

7. *E. acrobaphes* Turn.

(*Ornix acrobaphes* Turn., Trans. Roy. Soc. S. Austr. 1900, 22.)

Brisbane, Queensland, in January. Not known to me.

8. *E. australis*, Turn.

(*Ornix australis* Turn., Trans. Roy. Soc. S. Austr. 1896, 2.)

Brisbane, Queensland, from September to November.

4. Conopomorpha Meyr.

Characters of *Gracilaria*, but middle tibiæ not thickened, posterior tibiæ with series of projecting bristly hairs above.

Type *C. cyanospila* Meyr., from New Zealand. As explained under *Gracilaria*, I have recast the classification of that genus and its near allies. *Dialectica* Wals., is a synonym of this genus.

9. *C. ordinatella* Meyr.

(*Gracilaria ordinatella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 145.)

Burpengary, Queensland; Sydney, New South Wales; in May and June.

10. *C. irrorata* Turn.

(*Gracilaria irrorata* Turn., Trans. Roy. Soc. S. Austr. 1894, 124.)

Brisbane, Queensland; Sydney and Broken Hill, New South Wales; Adelaide, South Australia; from March to June, and in October.

11. *C. tricuneatella* Meyr.

(*Gracilaria tricuneatella* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 146.)

Brisbane, Queensland; Sydney, New South Wales; in April. Larva mining leaves of *Typha latifolia*.

12. *C. zaplaca*, n.sp.

♀. 10-11 mm. Head and thorax snow-white. Palpi white, apex of second joint and supramedian ring of terminal joint dark fuscous. Antennæ grey. Abdomen whitish-ochreous. Legs grey, tibiæ spotted or banded with white, anterior tibiæ dark fuscous towards apex, all tarsi white spotted with grey. Forewings elongate, very narrow, long-pointed, acute; brownish-ochreous; five direct snow-white fasciæ, edged with scattered black scales; first narrow, basal, confluent dorsally with second; second, third, and fourth very broad, only leaving narrow interspaces, irregular-edged, somewhat narrower on costa; fifth sub-

apical, very narrow, sinuate: cilia white, towards tornus pale greyish-ochreous, beneath apex with a grey bar, round apex with a fine black apical line. Hindwings grey; cilia pale greyish.

Sydney, New South Wales, in November and January; two specimens. Recognisable by the great relative breadth of the fasciæ.

13. *C. autadelpha* Meyr.

(*Gracilaria autadelpha* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 147.)

Brisbane, Queensland; Sydney and Mittagong, New South Wales; in September, February, and March.

14. *C. caenotheta* Meyr.

(*Gracilaria caenotheta* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 148.)

Blackheath, New South Wales, in January and March. Larva mining leaves of *Telopea speciosissima.*

15. *C. chionoplecta* Meyr.

(*Gracilaria chionoplecta* Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 195.)

Sydney, New South Wales, in October. Larva mining leaves of *Phebalium dentatum.*

16. *C. argyrodesma* Meyr.

(*Gracilaria argyrodesma* Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 194.)

Sydney, New South Wales, in September. Larva mining leaves of *Grevillea linearis.*

17. *C. trapezoides* Turn.

(*Gracilaria trapezoides* Turn., Trans. R. Soc. S. Austr. 1894, 123.)

Brisbane, Queensland. Not known to me.

18. *C. hoplocala* Meyr.

(*Gracilaria hoplocala* Meyr., Proc. Linn. Soc. N. S Wales, 1880, 149.)

Sydney, New South Wales, in October.

19. *C. calicella* Stt.

(*Gracilaria calicella* Stt., Trans. Ent. Soc. Lond., 3rd Ser., i., 297; Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 150; Turn., Trans. Roy. Soc. S. Austr. 1894, 124.)

Brisbane, Queensland; Sydney and Bulli, New South Wales; from July to October. Larva mining leaves of *Eucalyptus*.

20. *C. albimaculella* Turn.

(*Gracilaria albimaculella* Turn., Trans. Roy. Soc. S. Austr. 1894, 125.)

Brisbane, Queensland, in August. Not known to me.

21. *C. archepolis*, n.sp.

♀. 10 mm. Head and palpi white. Antennæ grey. Thorax white, patagia brown. Abdomen grey. Legs dark fuscous, banded with white, posterior pair white, ringed with dark fuscous. Forewings elongate, very narrow, long-pointed, acute; brownish-ochreous; markings white, edged with dark fuscous; an outwardly oblique fascia of white suffusion from base of dorsum, not reaching costa; an irregular fascia before middle, narrow on costa, moderately broad on dorsum, posteriorly sending a broad median projection to beyond middle of disc; a fascia from ⅔ of costa to tornus, upper half linear, lower half forming a triangular blotch; a dot on costa beyond this; an oblique streak before apex: cilia light ochreous-grey, white on extremities of subapical streak, at apex with a basal white dot followed by a black dot. Hindwings grey; cilia light grey.

Wirrabara, South Australia, in October; two specimens.

22. *C. euchlamyda* Turn.

(*Gracilaria euchlamyda* Turn., Trans. Roy. Soc. S. Austr. 1894, 126.)

Brisbane, Queensland, in August and September.

23. *C. obscurella* Turn.

(*Gracilaria obscurella* Turn., Trans. Roy. Soc. S. Austr. 1894, 125.)

Brisbane, Queensland, in September. Not known to me.

24. *C. habrodes*, n.sp.

♂♀. 9-10 mm. Head, palpi, antennæ, thorax, abdomen, and legs white; anterior femora and tibiæ suffusedly banded with dark fuscous, all tarsi spotted with fuscous. Forewings very elongate, very narrow, rather long-pointed, tolerably acute; very pale brassy-yellowish; markings white, partially edged anteriorly with scattered black scales, very undefined; eight or nine subtriangular costal spots, and four or five larger dorsal spots, two median sometimes united to form an irregular transverse fascia: cilia very pale yellowish, round apex suffusedly barred with white, at apex with a short blackish basal mark. Hindwings light grey; cilia grey-whitish, tinged with brassy-yellowish.

Geraldton, West Australia, in November; five specimens.

25. *C. eupetala* Meyr.

(*Gracilaria eupetala* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 160.)

Brisbane, Queensland; Sydney, New South Wales; in October and February. In this and the two following species the maxillary palpi are minute and easily overlooked, but when observable are formed as usual in the genus.

26. *C. eumetalla* Meyr.

(*Gracilaria eumetalla* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 160.)

Brisbane, Queensland; Sydney, New South Wales; Gisborne, Victoria; in September, October, and March. Larva in galls on *Acacia*.

27. *C. heliopla*, n.sp.

♂♀. 9-10 mm. Head and thorax shining coppery-bronze. Palpi ochreous-whitish, apex grey. Antennæ grey. Abdomen dark fuscous. Legs dark bronzy-fuscous. Forewings elongate, very narrow, long-pointed, acute; bright shining coppery-bronze; markings prismatic violet-white, edged with blackish; two short slender oblique streaks from costa before and beyond middle, and two others inwardly oblique towards apex, between these two

pairs a subcostal dash; a round dot in middle of disc, connected with dorsum by a direct slender whitish streak; a short slender longitudinal streak in disc beyond this, followed by a curved transverse mark touching a dorsal dot preceding it; a wedge-shaped mark from termen before apex forming a straight line with last costal mark; a rather undefined black apical dot: cilia dark grey, round apex grey-whitish with dark purplish-grey sub-basal shade and blackish subapical line. Hindwings dark fuscous; cilia dark grey.

Hobart, Tasmania, in December; two specimens.

28. *C. alysidota* Meyr.

(*Gracilaria alysidota* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 161.)

Brisbane, Queensland; Sydney, New South Wales; Sale and Healesville, Victoria; Port Lincoln, South Australia; Perth and Albany, West Australia; from September to December, and in March and July. Larva mining phyllodia (false leaves) of *Acacia longifolia.*

29. *C. antimacha*, n.sp.

♂. 9 mm. Head white. Palpi white, second joint with rough scales towards apex beneath, with dark fuscous subapical band, terminal joint rough-scaled anteriorly towards base, with dark fuscous median ring. Antennæ white ringed with fuscous. Thorax white, patagia light brownish. (Abdomen broken.) Legs white, banded with brownish, anterior tibiæ mostly dark fuscous. Forewings elongate, very narrow, moderately pointed, apex acute, somewhat produced; light brownish, sprinkled with dark fuscous; markings white, edged with dark fuscous suffusion; four oblique streaks from dorsum, reaching about half across wing, and four wedge-shaped somewhat shorter streaks from costa somewhat beyond these respectively, first dorsal extended on dorsum to base, first costal extended along costa to near base, second dorsal hooked at apex so as almost to meet first costal; a white suffusion in disc posteriorly between costal and dorsal streaks: cilia white,

obscurely barred with greyish, with a blackish median line round apex, and grey apical line. Hindwings and cilia pale grey.

Geraldton, West Australia, in November; one specimen.

30. *C. chionochtha*, n.sp.

♀. 9-10 mm. Head white. Palpi white, apical band of second joint and median ring of terminal joint blackish. Antennæ grey. Thorax white, patagia dark fuscous. Abdomen grey. Legs white, femora and tibiæ longitudinally striped with blackish, tarsi ringed with black. Forewings elongate, very narrow, long-pointed, apex acute; dark fuscous; a moderate white dorsal streak from base to near apex, edged above with some black scales, with three rounded projections before middle of wing, at tornus, and at posterior extremity respectively, dorsal edge yellowish-tinged: cilia grey, round apex suffusedly barred with white, at apex with three black hooks. Hindwings and cilia grey.

Quorn, South Australia, in October; two specimens.

31. *C. tristaniæ* Turn.

(*Gracilaria tristaniæ* Turn., Trans. Roy. Soc. S. Austr. 1894, 130.)

Brisbane, Queensland, from September to December. Larva mining leaves of *Tristania conferta* and *Eugenia Ventenatii*.

32. *C. parallela* Turn.

(*Gracilaria parallela* Turn., Trans. Roy. Soc. S. Austr. 1894, 130.)

Brisbane, Queensland, from July to November.

33. *C. heteropsis* Low.

(*Gracilaria heteropsis* Low., Trans. Roy. Soc. S. Austr. 1894, 112.)

Duaringa, Queensland. Not known to me.

34. *C. nereis* Meyr.

(*Gracilaria nereis* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 163; *G. fluorescens* Turn., Trans. Roy. Soc. S. Austr., 1894, 127.)

Brisbane, Queensland; Sydney, New South Wales; from August to November.

35. *C. laciniella* Meyr.

(*Gracilaria laciniella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 164).

Brisbane, Queensland; Sydney, Blackheath, Bathurst, and Mount Kosciusko (4,300 feet), New South Wales; Warragul and Gisborne, Victoria; Hobart, Launceston, Deloraine, and Campbelltown, Tasmania; Adelaide, South Australia; occurs more or less all the year round. Larva mining leaves of *Eucalyptus*.

36. *C. plebeia* Turn.

(*Gracilaria plebeia* Turn., Trans. Roy. Soc. S. Austr. 1894, 131.)

Brisbane, Queensland. Not known to me.

37. *C. unilineata* Turn.

(*Gracilaria unilineata* Turn., Trans. Roy. Soc. S. Austr. 1894, 131.)

Brisbane, Queensland. Not known to me.

38. *C. didymella* Meyr.

(*Gracilaria didymella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 164.)

Sydney, New South Wales; Melbourne, Victoria; Petersburg and Port Lincoln, South Australia; Albany, West Australia; from August to December. Larva mining blotches in phyllodia of *Acacia longifolia* and *A. cultriformis*.

39. *C. ochrocephala* Meyr.

(*Gracilaria ochrocephala* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 162.)

Sydney, New South Wales, in October and November.

40. *C. ophiodes* Turn.

(*Gracilaria ophiodes* Turn., Trans. Roy. Soc. S. Austr. 1896, 2.)

Brisbane and Warwick, Queensland, in September and October.

41. *C. albistriatella* Turn.

(*Gracilaria albistriatella* Turn., Trans. Roy. Soc. S. Austr. 1894, 129.)

Brisbane, Queensland.

42. *C. albomarginata* Stt.

(*Gracilaria albomarginata* Stt., Trans. Ent. Soc. Lond., 3rd Ser., i., 294, pl.x. 3.)

Brisbane, Queensland. Not known to me.

43. *C. leptalea* Turn.

(*Gracilaria leptalea* Turn., Trans. Roy. Soc. S. Austr. 1900, 21.)

Brisbane, Queensland, in August and September.

44. *C. pyrigenes* Turn.

(*Gracilaria pyrigenes* Turn., Trans. Roy. Soc. S. Austr. 1896, 1; *G. nitidula* ibid., 1894, 128 [præ-occup.].)

Brisbane, Queensland, in November.

45. *C. aeolella* Meyr.

(*Coriscium aeolellum* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 167.)

Wollongong, New South Wales, in October.

46. *C. ochridorsella* Meyr.

(*Coriscium ochridorsellum* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 166.)

Sydney, New South Wales, from November to February. Larva mining leaves of *Phyllanthus Ferdinandi.*

5. Cyphosticha, n.g.

Characters of *Conopomorpha*, but middle tibiæ elongated and thickened with dense scales.

Type *C. pyrochroma* Turn.

47. *C. microta* Turn.

(*Gracilaria microta* Turn., Trans. Roy. Soc. S. Austr. 1894, 128.)

Brisbane, Queensland. Not known to me, but the structural characters are given accurately by Dr. Turner in his description.

48 *C. pyrochroma* Turn.

(*Gracilaria pyrochroma* Turn., Trans. Roy. Soc. S. Austr. 1894 129.)

Brisbane, Queensland, in August and September.

6. MACAROSTOLA, n.g.

Characters of *Gracilaria*, but middle tibiæ not thickened, smooth-scaled, scales sometimes expanded at apex only.

Type *M. formosa* Stt. To this genus are referable the New Zealand species *leucocyma*, *aellomacha*, *aethalota* and *miniella*.

49. *M. thalassias* Meyr.

(*Gracilaria thalassias* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 158.)

Newcastle and Sydney, New South Wales; Melbourne, Victoria; from May to January. Larva mining leaves of *Leptospermum lævigatum* and *Agonis flexuosa*.

50. *M. toxomacha* Meyr.

(*Gracilaria toxomacha* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 197.)

Sydney, New South Wales, in September. Larva mining leaves of *Pultenæa daphnoides*.

51. *M. ophidias*, n.sp.

♂. 8 mm. Head white, crown centrally greyish-tinged. Palpi loosely rough-scaled anteriorly, white, with subapical band of second joint and median ring of terminal joint dark fuscous. Antennæ grey. Thorax fuscous. Abdomen grey. Legs grey, suffusedly ringed with white. Forewings elongate, very narrow, long-pointed, apex acute, produced; rather light fuscous; markings white, partially edged with scattered black scales; a very oblique wedge-shaped mark from costa before middle, extended as a narrow streak along costa to base; three similar marks from costa beyond this, each more or less distinctly extended on costa to touch preceding one, and two short direct marks before apex; a

thrice sinuate narrow subdorsal streak from base to tornus: cilia pale fuscous, round apex indistinctly barred with white, at apex with a black basal dot. Hindwings grey; cilia pale grey.

Quorn, South Australia, in October; one specimen.

52. *M. lyginella* Meyr.

(*Gracilaria lyginella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 157.)

Sydney, New South Wales, in October.

53. *M. amalopa*, n.sp.

♂♀. 7-8 mm. Head and thorax ochreous-white. Palpi whitish, apex of second joint and median ring of terminal joint dark fuscous. Antennæ whitish, dotted with fuscous above. Abdomen and legs ochreous-whitish, anterior legs obscurely banded with fuscous. Forewings elongate, very narrow, long-pointed, apex produced, acute; white, partially tinged with pale ochreous; markings brownish, more or less sprinkled with dark fuscous; nine oblique costal streaks, first three reduced to dots, fourth median, last four extended to termen; three oblique streaks from dorsum, first sometimes partially obsolete; a black apical dot: cilia whitish, round apex indistinctly barred with fuscous, extreme tips at apex black. Hindwings and cilia ochreous-grey-whitish.

Albany, West Australia, in December; six specimens.

54. *M. mnesicala* Meyr.

(*Gracilaria mnesicala* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 156.)

Sydney, New South Wales, in September.

55. *M. formosa* Stt.

(*Gracilaria formosa* Stt., Trans. Ent. Soc. Lond., 3rd Ser., i., 291, pl. x., 1; Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 153.)

Brisbane, Queensland; Sydney, New South Wales; from September to March. Dr. Turner thinks it is attached to *Eugenia Ventenatii*.

56. *M. polyplaca* Low.

(*Gracilaria polyplaca* Low., Trans. Roy. Soc. S. Austr. 1894, 112; Turn., Trans. Roy. Soc. S. Austr. 1900, 20.)

Duaringa and Brisbane, Queensland, from August to December, and in April. Attached apparently to *Tristania conferta* and *T. suaveolens.*

57. *M. ida* Meyr.

(*Gracilaria ida* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 155.)

Brisbane, Queensland; Glen Innes and Sydney, New South Wales; Melbourne, Victoria; Albany, West Australia; from July to March. Larva mining leaves of *Eucalyptus piperita* (?).

7. GRACILARIA Hw.

Head with appressed scales; tongue developed. Antennæ 1 or over 1, in ♂ filiform, basal joint without pecten. Labial palpi long, curved, ascending, smooth or sometimes partly or wholly rough-scaled anteriorly or with tuft of projecting scales on second joint, terminal joint about as long as second, more or less pointed. Maxillary palpi moderate, filiform, porrected. Middle tibiæ thickened and expanded with rough scales beneath, posterior tibiæ with appressed scales. Forewings with 1*b* simple, 2 from about $\frac{5}{6}$, 3 sometimes absent, 4 and 5 often approximated, 7 to costa, 11 from before middle or near base, secondary cell sometimes well defined. Hindwings about $\frac{1}{2}$, lanceolate or linear-lanceolate, cilia 4-6; 3 sometimes absent, transverse vein absent between 4 and 5, 5 and 6 stalked, their stalk often continued to base of wing, 7 from angle of cell or rarely out of 6.

Type *G. alchimiella* Sc., from Europe Study of increased material from various regions has convinced me that *Coriscium* Z., cannot be maintained as a distinct or natural genus, the scaling of the palpi being subject to much variation, and not according with true affinity. On the other hand, I have found it practicable to use the scaling of the legs to break up the whole of the species thus thrown together into four groups which are both natural and strictly definable, and since the number of species

known is already very large and destined to be much larger, I have thought it conducive to clearness to establish them as genera. The Indo-Malayan region is probably the home of this group.

58. *G. chalcoptera* Meyr.

(*Gracilaria chalcoptera* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 151.)

Brisbane, Queensland; Sydney, New South Wales; in March and April.

59. *G. octopunctata* Turn.

(*Gracilaria octopunctata* Turn., Trans. Roy. Soc. S. Austr. 1894, 123.)

Brisbane, Queensland, in April. Also occurs in India.

60. *G. lepidella* Meyr.

(*Gracilaria lepidella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 145.)

Sydney, New South Wales, in September and January.

61. *G. plagata* Stt.

(*Gracilaria plagata* Stt., Trans. Ent. Soc. Lond., 3rd Ser., i., 292, pl. x., 2; Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 144.)

Brisbane, Queensland, in September.

62. *G. albispersa* Turn.

(*Gracilaria albispersa* Turn., Trans. Roy. Soc. S. Austr. 1894, 121).

Brisbane, Queensland, in September.

63. *G. chlorella* Turn.

(*Gracilaria chlorella* Turn., Trans. Roy. Soc. S. Austr. 1894, 121.)

Brisbane, Queensland, in September. Not known to me.

64. *G. oenopella* Meyr.

(*Gracilaria oenopella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 141.)

Sydney, New South Wales, in May. Larva mining leaves of *Tetranthera ferruginea*.

65. *G. albicincta* Turn.

(*Gracilaria albicincta* Turn., Trans. Roy. Soc. S. Austr. 1900, 20.)

Brisbane, Queensland, in September. Not known to me.

66. *G. ischiastris*, n.sp.

♂. 8 mm. Head and thorax greyish-ochreous mixed with dark grey. Palpi white, second joint mostly blackish externally except a subapical ring, terminal joint with three black rings. Antennæ white ringed with dark fuscous. Abdomen dark grey. Legs dark fuscous, anterior and middle tarsi white, posterior coxæ and base of femora white, tibiæ white with dark grey subapical band, tarsi grey with two white rings. Forewings elongate, very narrow, very short-pointed, hardly acute; grey, closely irrorated with blackish; a short cloudy whitish mark from middle of dorsum, and between this and tornus some whitish irroration towards dorsum, tending to form an irregular strigulation; an oblique indistinct whitish mark from costa at $\frac{3}{4}$, and another more distinct and direct before apex, both preceded by darker suffusion: cilia grey, with thick subbasal and two posterior blackish lines, round apex white between subbasal and posterior lines. Hindwings rather dark grey; cilia grey.

Sydney, New South Wales, in November; one specimen.

67. *G. auchetidella* Meyr.

(*Gracilaria auchetidella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 143.)

Bulli, New South Wales, in October.

68. *G. cirrhopis*, n.sp.

♂. 9 mm. Head light ochreous-yellow. Palpi white, apex of second joint blackish, terminal joint suffused with blackish except at base above and towards apex. Antennæ white, suffusedly ringed with dark fuscous. Thorax ochreous-yellowish, shoulders dark purple-fuscous. Abdomen grey, apex ochreous-whitish. Legs dark purplish-fuscous, anterior coxæ yellowish, all tarsi

white with apex of joints dark fuscous. Forewings very elongate-lanceolate, long-pointed, apex somewhat produced; shining brassy-ochreous-yellow; costa dark fuscous-purple towards base; a moderate paler yellow dorsal streak from base to tornus; a suffused dark fuscous dot in disc above middle, whence proceeds a broad streak of pale purplish-fuscous suffusion to apex, strewn with a few dark fuscous scales: cilia whitish-ochreous. Hindwings grey; cilia pale grey.

George's Bay, Tasmania, in January; one specimen.

69. *G. aurora* Turn.

(*Gracilaria aurora* Turn., Trans. Roy. Soc. S. Austr. 1894, 127).

Brisbane, Queensland, in September. Not known to me.

70. *G. peltophanes*, n.sp.

♂♀. 8 mm. Head and thorax light brownish-ochreous, face ochreous-whitish. Palpi whitish, terminal joint with suffused dark fuscous band towards apex. Antennæ whitish, ringed with fuscous. Abdomen whitish-ochreous, mixed with grey above. Legs brownish-ochreous mixed with dark fuscous, anterior and middle tarsi white, apex sometimes dark fuscous, posterior legs whitish-ochreous with dark fuscous dots at apex of joints. Forewings elongate, very narrow, rather shortly pointed, acute; brownish-ochreous, suffused with pale fuscous; a triangular ochreous-whitish blotch extending on costa from $\frac{1}{5}$ to beyond middle, and reaching nearly to dorsum, edged with scattered black scales; a few black scales projecting from dorsum in cilia towards middle: cilia pale grey, round apex with several series of dark grey points. Hindwings rather dark grey; cilia grey.

Toowoomba, Queensland, in December; two specimens.

71. *G. xanthopharella* Meyr.

(*Gracilaria xanthopharella* Meyr., Proc. Linn. Soc. N.S.Wales, 1880, 141.)

Brisbane, Queensland; Sydney, New South Wales; from November to February.

72. *G. euglypta* Turn.

(*Gracilaria euglypta* Turn., Trans. Roy. Soc. S. Austr. 1894, 122.)
Brisbane, Queensland, in September.

73. *G. xylophanes* Turn.

(*Gracilaria xylophanes* Turn., Trans. Roy. Soc. S. Austr. 1894, 123.)

Brisbane, Queensland, in September.

74. *G. eurycnema* Turn.

(*Gracilaria eurycnema* Turn., Trans. Roy. Soc. S. Austr. 1894, 122.)

Brisbane, Queensland, in August and September. If I have correctly identified this species, the male has two very long hair-pencils rising from thorax posteriorly and lying along sides of abdomen.

8. TIMODORA Meyr.

75. *T. chrysochoa* Meyr.

(*Timodora chrysochoa* Meyr., Trans. Ent. Soc. Lond. 1886, 296.)
Tonga.

9. OPSICLINES, n.g.

Head with appressed scales; ocelli absent; tongue developed. Antennæ $\frac{5}{6}$, filiform, basal joint somewhat dilated, with pecten. Labial palpi moderately long, curved, ascending, second joint thickened with scales, somewhat roughly expanded towards apex beneath, terminal joint about half second, thickened with loose scales, obtuse. Maxillary palpi obsolete. Forewings with 2 from $\frac{5}{6}$, 3 absent, 6 and 7 stalked, 7 to costa, 8 absent, 11 from middle. Hindwings $\frac{1}{2}$, narrow-lanceolate, cilia 4; 3 absent, 5-7 parallel.

A genus of somewhat dubious affinity; it may be a development of *Zelleria*. My example, kindly communicated by Mr. Lower, is a female, and the posterior legs are broken.

76. *O. leucomorpha* Low.

(*Zelleria leucomorpha* Low., Proc. Linn. Soc. N. S. Wales, 1900, 422.)

Adelaide, South Australia, in December.

10. Macarangela Meyr.

77. *M. pyracma* Meyr.

(*Macarangela pyracma* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 589.)

York, West Australia, in October.

78. *M. uranarcha* Meyr.

(*Macarangela uranarcha* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 588.)

Mount Lofty, South Australia.

79. *M. leucochrysa* Meyr.

(*Macarangela leucochrysa* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 588.)

Sydney, New South Wales, in October.

11. Zelleria Stt.

80. *Z. cynetica* Meyr.

(*Zelleria cynetica* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 582.)

Brisbane, Queensland; Murrurundi, Sydney, and Blackheath, New South Wales; Gisborne, Victoria; Launceston, Deloraine, Hobart, and George's Bay, Tasmania; from October to December, and in March and April.

81. *Z. araeodes* Meyr.

(*Zelleria araeodes* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 582).

Sydney, New South Wales; Geraldton and Albany, West Australia; from August to October.

82. *Z. hemixipha* Low.

(*Zelleria hemixipha* Low., Proc. Linn. Soc. N. S. Wales, 1900, 421.)

Adelaide, South Australia, in November.

83. *Z. memorella* Meyr.

(*Zelleria memorella* Meyr.,Proc.Linn.Soc.N.S.Wales,1892,583.)

Sydney and Mt. Kosciusko, New South Wales; Gisborne, Victoria; Hobart and George's Bay, Tasmania York and Albany, West Australia; from November to January.

84. *Z. cremnospila* Low.

(*Zelleria cremnospila* Low., Proc. Linn. Soc N. S.Wales, 1900, 421.)

Port Victor, South Australia, in November.

85. *Z. aphrospora* Meyr.

(*Zelleria aphrospora* Meyr., Proc. Linn. Soc. N. S.Wales, 1892, 584.)

Port Lincoln, South Australia, in November.

86. *Z. callidoxa* Meyr.

(*Zelleria callidoxa* Meyr., Proc.Linn.Soc.N.S.Wales,1892,584.)

Port Lincoln and Mt. Lofty, South Australia, in November.

87. *Z. proterospila* Meyr.

(*Zelleria proterospila* Meyr., Proc. Linn. Soc. N. S.Wales, 1892, 584.)

Geraldton, York, and Albany, West Australia, from October to December.

88. *Z. pyroleuca* Meyr.

(*Zelleria pyroleuca* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 585.)

Bathurst, New South Wales, in November.

89. *Z. mystarcha* Meyr.

(*Zelleria mystarcha* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 586.)

Campbelltown, Tasmania, in December.

90. *Z. citrina* Meyr.

(*Zelleria citrina* Meyr., Proc. Linn. Soc. N.S. Wales, 1892, 586.)

Sydney and Glen Innes, New South Wales, in September and December.

91. *Z. sigillata* Meyr.

(*Zelleria sigillata* Meyr., Proc. Linn. Soc. N.S. Wales, 1892, 587.)

Sydney and Shoalhaven, New South Wales, in December and January.

92. *Z. stylograpta*, n.sp.

♀. 20 mm. Head and thorax grey, finely irrorated with white. Palpi whitish, sprinkled with grey. Antennæ grey. Forewings very elongate-lanceolate, round-pointed; 4 and 5 stalked; pale whitish-fuscous finely irrorated with dark fuscous, appearing grey; a minute blackish dot in disc at $\frac{1}{5}$; an oblique blackish streak in disc before middle, not reaching margins; some blackish irroration towards apex: cilia grey, round apex suffused with dark purple-fuscous. Hindwings grey, paler and thinly scaled towards base; cilia light grey.

Mt. Macedon, Victoria, in March; one specimen (Lower).

12. Xyrosaris, n.g.

Head with short dense rough hairs; tongue developed; ocelli absent. Antennæ over 1, in ♂ filiform, basal joint moderate, with pecten. Labial palpi moderately long, curved, ascending, second joint thickened with dense scales, expanded and projecting towards apex beneath, terminal joint longer than second, expanded with rough projecting scales above and beneath to form a dense rough brush-like tuft concealing apex of joint. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled. Forewings with small tufts of scales on surface; 2 from angle, 7 to apex or termen, 11 from towards base. Hindwings 1, elongate-lanceolate, cilia nearly 2; 3 absent, 5 and 6 closely approximated.

Certainly allied to *Zelleria*, but abundantly distinct by the long antennæ, peculiar palpi, and scale-tufts of forewings. I have two allied species from Ceylon.

93. *X. dryopa*, n.sp.

♂. 18 mm. Head ochreous-whitish irrorated with pale fuscous. Palpi rather dark fuscous irrorated with whitish, internally whitish. Antennæ fuscous, obscurely paler-ringed. Thorax pale greyish-ochreous tinged with brown. Abdomen grey, anal valves very large. Forewings very elongate, very narrow, apex short-pointed, obtuse; pale greyish-ochreous, partially tinged with brown; two undefined patches of brown suffusion in disc anteriorly, including two or three small dark fuscous scaletufts; a narrow brown streak along dorsum from middle to near tornus, including two dark fuscous scaletufts; some small black dots on posterior half of costa and forming a curved subterminal series to tornus; some brown suffusion towards apex, including a transverse mark of raised fuscous scales: cilia pale greyish-ochreous, towards tornus suffused with dark grey, round apex and on costa with two broad dark grey shades. Hindwings grey, becoming thinly scaled and subhyaline towards base; cilia grey.

Brisbane, Queensland; one specimen.

13. CYCLOTORNA, n.g.

Head with appressed scales; tongue absent; ocelli present. Antennæ $\frac{4}{5}$, in ♂ filiform, simple, basal joint short, thick, with scaletuft anteriorly. Labial palpi minute, scaled, obtuse. Maxillary palpi obsolete. Abdomen thick. Posterior tibiæ with dense long hairs above. Forewings with 1*b* furcate, 2 from angle, 7 to apex, 8-10 approximated, 11 from middle, secondary cell defined. Hindwings 1, elongate-ovate, cilia $\frac{1}{2}$; 3 and 4 connate or stalked, 5-7 parallel, 8 free.

This curious form is probably a modification of *Homadaula*.

94. *C. monocentra*, n.sp.

♂♀. 23-30 mm. Head, palpi, and thorax dark fuscous finely irrorated with whitish. Antennæ fuscous. Abdomen ochreous-fuscous. Forewings elongate, moderate, costa rather strongly arched, apex rounded, termen obliquely rounded, dorsum strongly arched before middle; dark grey, partially tinged with ochreous-

brownish, finely irrorated with whitish, and strewn with blackish or dark fuscous scales; some undefined darker suffusion towards costa before middle; a narrow or linear transverse dark fuscous mark in disc before $\frac{3}{4}$: cilia grey irrorated with whitish. Hindwings in ♂ dark fuscous, in ♀ fuscous, somewhat ochreous-tinged; hairs on $1b$ tinged with ochreous; cilia light ochreous-fuscous, basal half in ♂ dark fuscous.

Townsville and Duaringa, Queensland, in April (Barnard, Dodd, Lower); five specimens. Mr. Dodd states that "the larva has two stages, one bug-like, the other rayed; in the latter stage it lives in the nests of ants; the change of shape is effected in a small cocoon."

14. Homadaula, n.g.

Head smooth, sidetufts somewhat spreading; tongue developed; ocelli absent. Antennæ $\frac{3}{4}$, in ♂ serrulate, shortly ciliated, basal joint moderate, without pecten. Labial palpi moderate, straight, porrected or subascending, second joint thick, shortly rough-scaled, terminal joint short, stout, cylindrical, obtuse. Maxillary palpi rudimentary. Posterior tibiæ with appressed scales. Forewings with $1b$ furcate, 2 from near angle, 7 to apex or termen, 11 from middle, secondary cell defined. Hindwings 1, elongate-ovate, cilia $\frac{3}{5}$; 3 and 4 connate or stalked, 5-7 parallel.

Type *H. myriospila*. Probably related to *Anticrates*, from which it differs mainly by the peculiar palpi.

95. *H. coscinopa* Low.

(*Homadaula coscinopa* Low., Proc.Linn.Soc.N.S.Wales, 1900, 51.)

Broken Hill, New South Wales, in March.

96. *H. myriospila*, n.sp.

♂♀. 13-17 mm. Head and thorax grey sprinkled with whitish. Palpi blackish, apex grey. Antennæ and abdomen grey. Forewings elongate, costa moderately arched, apex rounded, termen rather obliquely rounded; grey, finely irrorated with white, strewn with numerous dark fuscous dots; the absence of white irroration

generally forms a subquadrate blotch on costa before middle, its anterior edge darker and tending to be produced to dorsum, but this is sometimes obsolete or reduced to a spot in disc; a more or less distinct small dark spot above dorsum before tornus: cilia grey, with lines of white points. Hindwings ochreous-grey, becoming darker towards apex; cilia grey, becoming whitish towards tips.

Carnarvon and Geraldton, West Australia, in November and December; ten specimens, all bred. Larva feeds on an unidentified phyllodineous species of *Acacia*, living gregariously in dense masses of web amongst the phyllodia, in October.

97. *H. poliodes*, n.sp.

♂♀. 11-12 mm. Head white, sprinkled with grey. Palpi dark grey, apex of joints whitish. Antennæ grey. Thorax white, indistinctly spotted with grey. Abdomen grey. Forewings elongate, costa moderately arched, apex obtuse, termen obliquely rounded; grey, densely and suffusedly irrorated with white; some scattered rather dark fuscous dots; markings rather dark fuscous; a triangular spot on dorsum near base; a moderately broad fascia at $\frac{1}{3}$, attenuated or obsolete on costa; an irregular blotch on dorsum before tornus; an irregular spot on costa at $\frac{3}{4}$, and another on termen above tornus, sometimes confluent: cilia rather dark grey, with rows of white points. Hindwings rather dark grey, lighter towards base; cilia light grey.

York, West Australia, in November; two specimens.

98. *H. lasiochroa* Low.

(*Homadaula lasiochroa* Low., Proc. Linn. Soc. N. S. Wales, 1899, 115.)

Broken Hill, New South Wales, in October and January.

15. Prays Hb.

Head with appressed scales; tongue developed. Antennæ $\frac{3}{4}$, in ♂ minutely ciliated or pubescent, basal joint without pecten. Labial palpi moderate, curved, subascending, second joint some-

what rough beneath, terminal joint as long as second or longer, pointed. Maxillary palpi rudimentary. Posterior tibiæ smooth-scaled. Forewings with 1*b* furcate, 2 from $\frac{4}{5}$, 7 and 8 approximated at base or stalked, 7 to termen, 9 and 10 approximated, 11 from beyond middle. Hindwings 1, elongate-ovate, cilia $\frac{2}{3}$-1; 4 absent, 6 and 7 parallel.

1.	Head yellowish or whitish-ochreous	2.
	Head grey	4.
2.	Forewings with dark transverse markings	3.
	Forewings with marginal spots only	99. *tyrastis*.
3.	Forewings with dark fascia at $\frac{1}{4}$	100. *inscripta*.
	Forewings without dark fascia at $\frac{1}{4}$	101. *calycias*.
4.	Forewings with median dorsal spot fascia-like	102. *nephelomima*.
	Forewings with median dorsal spot not crossing fold	103. *autocasis*.

99. *P. tyrastis*, n.sp.

♂. 12-15 mm. Head and palpi light ochreous-yellow. Antennæ fuscous. Thorax whitish-yellowish, anterior margin dark fuscous. Abdomen pale grey-yellowish. Forewings very elongate, costa posteriorly moderately arched, apex obtuse, termen oblique, somewhat rounded; whitish-yellowish; markings dark fuscous; two small spots on costa near base and at $\frac{1}{4}$, connected by a narrow costal streak; two dots on costa about middle, and a spot or dot at $\frac{3}{4}$; a spot on dorsum at $\frac{1}{3}$, a larger one beyond middle, and a triangular one at tornus; an irregular streak from apex along termen to below middle: cilia whitish-ochreous, with fuscous bars below apex and above tornus, or mostly fuscous. Hindwings and cilia grey.

Geraldton, West Australia; Melbourne, Victoria; in November, three specimens.

100. *P. inscripta*, n.sp.

♂♀. 11-13 mm. Head ochreous-yellowish. Palpi, antennæ, thorax, and abdomen rather dark fuscous. Forewings very elongate, costa gently arched, apex obtuse, termen obliquely rounded; ochreous-white, towards dorsum more ochreous-tinged; markings dark ochreous-fuscous; a streak along anterior half of costa; three narrow fasciæ, first at $\frac{1}{4}$, sometimes not reaching

dorsum, second from $\frac{2}{3}$ of costa to $\frac{2}{3}$ of dorsum, connected in middle by a bar with apex of costal streak, third from costa near apex to tornus; generally a more or less partial streak along termen, sometimes partly confluent with third fascia: cilia fuscous. Hindwings rather dark purplish-fuscous; cilia fuscous.

Sydney, New South Wales, in August, September, March, and April; ten specimens, all in Waverley Gully.

101. *P. calycias*, n.sp.

♂♀. 10-11 mm. Head whitish-ochreous, yellowish-tinged. Palpi and antennæ grey. Thorax and abdomen rather dark fuscous. Forewings very elongate, costa gently arched, apex round-pointed, termen very obliquely rounded; rather dark fuscous; markings pale whitish-ochreous; a large rounded-triangular blotch extending on dorsum from base to middle, apex almost reaching costa at $\frac{1}{4}$; one or two obscure dots towards middle of costa; a rather narrow irregular fascia from $\frac{4}{5}$ of costa to dorsum before tornus: cilia fuscous, tips whitish on a spot beneath apex. Hindwings rather dark fuscous, with prismatic reflections; cilia fuscous.

Brisbane, Queensland; Sydney, New South Wales; from September to November, five specimens.

102. *P. nephelomima*, n.sp.

♂♀. 10-12 mm. Head and thorax grey mixed with white. Palpi grey. Antennæ whitish-grey. Abdomen grey. Forewings very elongate, costa gently arched, apex round-pointed, termen very obliquely rounded; grey, suffused with whitish and mixed with dark fuscous, tending to form transverse strigulæ; markings cloudy, indistinct, formed by dark fuscous suffusion; a spot on costa at $\frac{1}{4}$, and another at $\frac{3}{4}$; an oblique fascia-like spot from dorsum beyond middle, reaching more than half across wing and tending to unite with second costal spot; a triangular spot on tornus: cilia grey, mixed with whitish on costa. Hindwings and cilia fuscous-grey.

Murrurundi and Sydney, New South Wales, in November and December; five specimens.

103. *P. autocasis*, n.sp.

♀. 11-12 mm. Head pale grey, yellowish-tinged, face more whitish. Palpi, antennæ, thorax, and abdomen grey. Forewings very elongate, costa gently arched, apex round-pointed, termen very obliquely rounded; grey, densely irrorated with white, and transversely strigulated with darker grey; an indistinct cloudy darker spot on dorsum beyond middle, not crossing fold, and another on tornus: cilia grey, on costa mixed with white. Hindwings grey, with brassy and purplish reflections; cilia grey.

Sydney, New South Wales; Albany, West Australia; in October and April, two specimens.

16. YPONOMEUTA Latr.

104. *Y. internellus* Walk.

(*Hyponomeuta internellus* Walk. 533; *H. pustulellus* ib. 533, Turn., Proc. Linn. Soc. N.S. Wales, 1903, 77; *H. grossipunctella* Gn., Ann. Soc. Ent. Fr. 1879, 282.)

Mackay, Townsville, Brisbane, and Warwick, Queensland; Glen Innes, Newcastle, and Sydney, New South Wales; from June to January.

105. *Y. myriosemus* Turn.

(*Hyponomeuta myriosema* Turn., Trans. Roy. Soc. S. Austr., 1898, 200.)

Duaringa, and Brisbane, Queensland; Katoomba, New South Wales; in August and November.

106. *Y. interruptellus* Saub.

(*Teinoptila interruptella* Saub., Semp. Schmett. Phil. ii., 701, pl. lxvi., 16.)

Port Moresby, New Guinea; a specimen received from Dr. Turner; occurs also in the Philippines. A curious blackish species, with two or three very irregular rather large white spots towards dorsum of forewings; it is a true *Yponomeuta*, and the genus *Teinoptila* Saub., lapses.

17. THYRIDECTIS Meyr.

107. *T. psephonoma* Meyr.

(*Thyridectis psephonoma* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, 1046.)

Newcastle, New South Wales.

18. ATTEVA Walk.

The species of this genus, notwithstanding their conspicuous colouring, are often very similar and difficult, and require close attention. The colour and markings of the head and thorax, and the modifications of the posterior tibiæ of the male, frequently afford reliable distinctions. *A. fulviguttata* Z., is attributed conjecturally to Australia, but in error; it is really West Indian.

108. *A. aurata* Butl.

(*Corinea aurata* Butl., Ann. Mag. Nat. Hist. 1882, 238.)

25 mm. Forewings golden-orange. Hindwings orange, apical half greenish-black.

Duke of York Island (Bismarck Archipelago). Only type seen.

109. *A. rex* Butl.

(*Corinea rex* Butl., Ann. Mag. Nat. Hist. 1887, 414.)

♂. 25-26 mm. Head dark grey, a streak along anterior margin of eye, a patch behind eye, and a spot or mark on back of crown white. Thorax and abdomen orange, anal valves very long. Posterior tibiæ and tarsi whitish, very weak and deformed. Forewings narrow, posteriorly dilated, costa posteriorly strongly arched, apex obtuse, termen faintly sinuate, rather oblique; bright orange, posteriorly coppery-tinged; a suffused deep purple terminal fascia, occupying about $\frac{1}{6}$ of wing, broadest on costa. Hindwings thinly scaled, bright orange; apical $\frac{2}{5}$ dark grey.

Bougainville, Solomon Is.; two specimens (Meek); types also seen.

110. *A. albitarsis* Feld.

(*Amblothridia albitarsis* Feld., Reis. Nov., pl.cxxxix (note).)

Locality not given, but it would seem to be probably from the Australian region. Not known to me; described as golden-orange, with costa and termen of forewings narrowly black.

111. *A. porphyris* n.sp.

♀. 27-29 mm. Head, palpi, and antennæ blackish, face and a patch behind eyes white. Thorax bright orange. Abdomen orange, above deep purple becoming blackish posteriorly, beneath with apical segment white and præapical purple-blackish. Legs purple-blackish, spotted with white. Forewings elongate, rather narrow, costa gently arched, apex rounded, termen rather obliquely rounded; very deep indigo-blue-purple; basal area almost to middle bright orange: cilia dark purple-fuscous, tips pale fuscous. Hindwings somewhat thinly scaled, bright orange; apical half dark purplish-fuscous, produced along dorsum to near termen; cilia dark purplish-fuscous, tips paler, becoming orange on dorsum.

Bougainville, Solomon Is.; two specimens (Meek).

112. *A. iris* Feld.

(*Amblothridia iris* Feld., Reis. Nov. pl. cxxxix., 25.)

Molucca Is.; not known to me. Similar to preceding, but with orange area much smaller, occupying only about a fourth of wing.

113. *A. teratias*, n.sp.

♂♀. 30-33 mm. Head dark grey, a streak along anterior margin of eye, a patch behind eye, and sometimes a dot on forehead and another on crown white. Palpi and antennæ dark grey. Thorax and abdomen bright orange, abdomen in ♂ with white ventral stripe, anal valves very long. Legs dark grey, apex of middle tibiæ whitish, posterior legs white suffused with orange above, posterior tibiæ in ♂ short and weak, loosely rough-scaled above. Forewings very elongate, narrow, costa posteriorly

gently arched, apex rounded, termen somewhat obliquely rounded; dark fuscous-purple, in ♂ suffused with deep indigo in disc; basal $\frac{2}{5}$ bright orange, division suffused; an elongate white spot in disc somewhat before middle; a variable roundish or irregular white spot in disc somewhat before $\frac{3}{4}$, above which are one or two minute white dots: cilia rather dark fuscous. Hindwings blackish-fuscous; basal $\frac{2}{5}$ bright orange; cilia grey, on basal area orange.

Woodlark I. Sariba I.; two specimens (Meek).

114. *A. cuprina* Feld.

(*Amblothridia cuprina* Feld., Reis. Nov. pl. cxxxix., 21.)

Molucca Is.; not known to me. Forewings purple, with an orange basal patch extended along dorsum to tornus, and four white spots in the purple area; hindwings orange, with grey apical patch.

115. *A. basalis* Voll.

(*Oeta basalis* Voll., Tijd. v. Ent. 1863, 140, pl. ix., 6.)

Mortai (Moluccas); other localities quoted by various authors require confirmation, the identity of the species observed not being established. This and the two following species are nearly allied, and the group requires further study.

116. *A. conspicua* Wals.

(*Atteva conspicua* Wals., Swinh. Cat. Het. ii., 559.)

Buru; not known to me.

117. *A. Mathewi* Butl.

(*Corinea Mathewi* Butl., Ann. Mag. Nat. Hist. 1887, 414.)

♂♀. 30-35 mm. Head blackish-grey, a streak along anterior margin of eye, a patch behind eye, and undefined spots on forehead and back of crown white. Thorax and abdomen orange. Posterior tibiæ in ♂ somewhat short but normal, smooth-scaled. Forewings purple-blackish; basal $\frac{2}{5}$ deep orange; a white spot on dorsum near base, and one in disc at $\frac{1}{5}$; a variable transverse white mark before middle, seldom reaching dorsum; a white dot

on costa near beyond this, sometimes almost touching it; three small variable white spots beneath costa on posterior half, sometimes accompanied by one or two additional dots; a rather large pear-shaped white spot above dorsum before tornus, sometimes touching dorsum or connected with penultimate subcostal spot. Hindwings thinly scaled, bright orange; apical half, or rather less, grey, on termen blackish.

Kulambangra, Florida Guadalcanar, Choiseul, Gizo, Rendova, probably throughout the Solomon Is. (Meek); fourteen specimens. My former quotation of *A. apicalis* Voll., from these islands was founded on a mistaken identification of this species.

118. *A. albiguttata* Z.

(*Oeta albiguttata* Z., Zool. Bot. Ver. 1873, 230; *Atteva albiguttata* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 80.)

Maryborough and Brisbane, Queensland, in April (Barnard, Turner).

119. *A. charopis* Turn.

(*Atteva charopis* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 80.)

Cooktown and Cairns, Queensland (Dodd).

120. *A. megalastra*, n.sp.

♂♀. 29-30 mm. Head ochreous-whitish. Palpi dark grey, base ochreous-whitish. Antennæ grey. Thorax deep orange, apical margin of collar, and a spot on outer side of patagia white, and a transverse ochreous-whitish bar before posterior extremity. Abdomen bright orange, beneath with segments white towards middle of posterior margin. Legs dark fuscous, spotted with white, posterior tibiæ in ♂ clothed with dense long hairs above and beneath. Forewings elongate, costa anteriorly nearly straight, posteriorly moderately arched, apex obtuse, termen rather oblique, hardly rounded; deep fulvous-orange, with numerous mostly roundish white spots; about twelve small ones on costa, tenth largest; five moderate spots, with two or three variable small additional dots, in a supramedian longitudinal series, first and third sometimes touching costal spots, second central, fifth almost

apical; a moderate spot above dorsum near base; two large spots in disc at about $\frac{2}{5}$ and $\frac{4}{5}$; five or six small spots on dorsum, of which one beyond middle is larger and transverse; a more or less transverse spot beyond tornus, and sometimes some additional variable dots above this: cilia orange, towards tips white round apex. Hindwings bright orange; cilia orange, tips paler.

Port Douglas, Queensland; two specimens (Lucas).

121. *A. niphocosma* Turn.

(*Atteva niphocosma* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 79.)

Townsville and Brisbane, Queensland, in February and March (Turner). Not known to me.

122. *A. myriastra*, n.sp.

♀. 34 mm. Head white mixed with whitish-ochreous. (Palpi broken). Antennæ dark grey. Thorax deep orange, apical half of collar and a spot on outer side of patagia white (probably with a whitish bar before posterior extremity, but defaced). Abdomen bright orange, beneath with segments white towards middle of posterior margin. Legs dark fuscous, spotted with white. Forewings elongate, costa gently arched, apex obtuse, termen almost straight, somewhat oblique; fulvous-orange, with numerous white spots; about thirteen small ones on costa, eleventh largest; eleven small or moderate spots in an irregular subcostal series; about eight in an irregular submedian series, variable in size, two transverse spots about $\frac{3}{4}$ connected, eighth transverse; about nine small dorsal spots, one beyond middle larger and transverse: cilia orange, tips paler. Hindwings and cilia bright orange.

Maryborough, Queensland; one specimen (Barnard).

19. CORYPTILUM Z.

Head shortly rough-haired. Antennæ $\frac{5}{6}$ to almost 1, in ♂ filiform, simple, basal joint short, without pecten. Labial palpi moderate, curved, ascending, with rough projecting hairs beneath throughout, terminal joint shorter than second, obtuse. Maxillary

palpi moderate, filiform, subascending. Posterior tibiæ with appressed scales. Forewings with 2 from near angle, 7 to costa, 11 from $\frac{1}{4}$ of cell, secondary cell defined. Hindwings 1, elongate-ovate, cilia $\frac{1}{4}$; 3 and 4 somewhat approximated, 5 and 6 approximated.

A peculiar genus of somewhat uncertain affinity, perhaps nearer the *Tortyra* group.

123. *C. Klugii* Z.

(*Coryptilum Klugii* Z., Is. 1839; *Sippharara euchromiella* Walk. Suppl. 1822; *S. Woodfordi* Druce, Proc. Zool. Soc. Lond. 1888, 579, pl. xxix., 8.)

♂♀. 32-40 mm Head black. Thorax coppery-red, suffusedly striped with black. Abdomen blackish. Forewings elongate, posteriorly dilated, costa posteriorly strongly arched, apex obtuse, termen obliquely rounded; orange, mostly suffused with deep coppery-red; costal edge blackish; a blackish patch, strewn with bright bluish-silvery-metallic scales, extending along dorsum from near base to near tornus; a broad black oblique subapical patch from costa posteriorly, not quite reaching termen, marked with several streaks of bright bluish-silvery-metallic scales on veins; two more or less indicated short black and silvery-metallic streaks on veins towards tornus. Hindwings black; apical third bright orange.

Rendova, Isabel, Gizo, Solomon Is.; Milne Bay, New Guinea; Rossel I.; Gilolo; twelve specimens. Occurs also in the Philippines, Celebes, Sumatra, Java, and Malacca.

20. Tonza Walk.

124. *T. purella* Walk.

(*Tonza purella* Walk. 1011; Meyr., Proc. Linn. Soc. N.S.Wales, 1892, 591.)

Townsville and Rockhampton, Queensland, in November, February, and May.

21. Anticrates Meyr.

Head loosely haired or with appressed scales; tongue developed. Antennæ $\frac{3}{4}$-$\frac{4}{5}$, in ♂ moderately or shortly ciliated, basal joint

sometimes with pecten. Labial palpi moderately long, curved, ascending, with appressed scales, terminal joint shorter than second, pointed. Maxillary palpi rudimentary. Posterior tibiæ with appressed scales. Forewings with 1*b* furcate, 2 from angle, 2 and 3 sometimes stalked, 7 to termen, 7 and 8 or 8 and 9 sometimes stalked, 11 from before middle. Hindwings 1, elongate-ovate, cilia $\frac{1}{5}$-$\frac{1}{2}$; 3 and 4 connate or stalked, 5-7 tolerably parallel.

An Indo-Malayan genus of moderate extent.

125. *A. isanema*, n.sp.

♂♀. 18-20 mm. Head, palpi, antennæ, thorax, and abdomen white, second joint of palpi pale ochreous except towards apex, terminal joint obviously shorter than second. Forewings elongate, costa moderately arched, apex tolerably pointed, termen faintly sinuate, rather strongly oblique, 8 and 9 stalked; white; sometimes two or three minute dark fuscous dots on costa towards apex, and on dorsum towards tornus: costal cilia whitish-ochreous, near apex white; terminal cilia pale ochreous, becoming fuscous towards tips, base white, with a minute blackish apical dot. Hindwings and cilia white.

Mount Wellington, Tasmania, at 3000 feet, in December and January, apparently attached to *Correa speciosa*; nine specimens.

126. *A. drosochlora*, n.sp.

♀. 17 mm. Head, palpi, antennæ, thorax, and abdomen white, terminal joint of palpi almost as long as second. Forewings elongate, costa moderately arched, apex pointed, termen almost straight, rather strongly oblique, 8 and 9 stalked; white, strewn throughout with scattered pale brownish-ochreous scales; a series of minute dark fuscous specks round apical portion of costa and termen: cilia pale ochreous, towards base white, sprinkled with pale brownish-ochreous. Hindwings and cilia white.

Sydney, New South Wales, in August, amongst *Correa speciosa*; one specimen.

127. *A. sulfurata*, n.sp.

♂ 18 mm., ♀ 27 mm. Head and thorax in ♂ pale yellow, in ♀ brownish-ochreous. Palpi in ♂ moderate, ochreous-whitish,

terminal joint nearly equal second, in ♀ longer, more recurved, brownish-ochreous, terminal joint much shorter than second. Antennæ whitish ochreous. Abdomen whitish. Forewings elongate, costa gently arched, apex obtuse, termen somewhat rounded, oblique, 7 and 8 stalked; very pale shining brassy-yellowish: cilia whitish. Hindwings and cilia white.

York, West Australia, in November, 1 ♂; Ardrossan, South Australia, 1 ♀. I have no doubt these are the same species, but in case of error I specify the male as the type.

128. *A. paraxantha*, n.sp.

♀. 16 mm. Head ochreous-yellow. Palpi whitish-ochreous, second joint externally crimson-tinged. Antennæ whitish-ochreous. Thorax yellow, collar and posterior third mixed with dull crimson. Abdomen pale ochreous, tinged with crimson. Forewings elongate, costa moderately arched, apex obtuse, termen little rounded, oblique, 7-9 separate; yellow, with a few scattered pale crimson scales in disc and posteriorly; base narrowly pale crimson, shortly produced along costa; an ill-defined and partially interrupted cloudy pale crimson streak from $\frac{1}{3}$ of dorsum to $\frac{4}{5}$ of costa; an inwardly oblique pale crimson streak from dorsum before tornus, terminating in previous streak at right angles: cilia yellow, slightly crimson-tinged. Hindwings and cilia light ochreous-crimson.

Rockhampton, Queensland; one specimen (Barnard).

129. *A. zapyra*, n.sp.

♂. 16 mm. Head pale yellow, crown red posteriorly. Palpi reddish. Antennæ whitish-yellowish. Thorax pale yellow, with red transverse median band. Abdomen coppery-ochreous. Forewings elongate, costa gently arched, apex obtuse, termen somewhat rounded, oblique, 7-9 separate; pale brassy-yellow; markings crimson-red, paler on costal half, deepest towards dorsum; costal edge crimson towards base; a subdorsal streak from base to $\frac{1}{4}$ of dorsum, connected there with a median streak from before middle of dorsum to near costa at $\frac{4}{5}$; a streak from base of costa termina-

ting in median streak on fold, and connected with middle of subdorsal streak by a bar parallel to median streak and continued upwards to meet next streak; a slender curved streak rising from this near base and continued through middle of disc to tornus, joined at right angles by a thick streak from ⅔ of dorsum parallel to median; above this the whole wing is marked by cloudy interneural streaks not quite reaching margin: cilia light crimson-ochreous, basal third dull crimson. Hindwings and cilia crimson-ochreous.

Toowoomba, Queensland, in December; one specimen.

22. LACTURA Walk.

Characters are given by Dr. Turner, but 7 and 8 of forewings sometimes stalked. I include *Epidictica* Turn., as a synonym of this genus. It appears to be confined to the Australian region.

130. *L. caminaea* Meyr.

(*Enaemia caminaea* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, 1044.)

Newcastle and Sydney, New South Wales, in April. Larva on *Eucalyptus*; figured and described by Olliff, Ann. Mag. Nat. Hist. 1888, 361, pl. xx., 5; if there is no error of observation, it is very abnormal in form.

131. *L. egregiella* Walk.

(*Cyptasia egregiella* Walk., Suppl. 1837; *Lactura egregiella* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 84.)

Duaringa, Wide Bay, and Rosewood, Queensland, in October.

132. *L. dives* Walk.

(*Lactura dives* Walk., Bomb. 486; Turn., Proc. Linn. Soc. N. S. Wales, 1903, 89.)

Townsville, Queensland, in March.

133. *L. laetifera* Walk.

(*Themiscyra laetifera* Walk., Suppl. 258; *Enaemia pyrochrysa* Low., Trans. Roy. Soc. S. Austr. 1894, 111; *Lactura laetifera* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 85.)

Cairns, Bundaberg, and Brisbane, Queensland.

134. *L. suffusa* Walk.

(*Dianasa suffusa* Walk., Bomb. 488; *Hypoprepia haematopus* Feld., Reis. Nov. pl. cxxxix., 54, 55; *Dianasa obscura* Butl., Trans. Ent. Soc. Lond. 1877, 346; *Lactura suffusa* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 88.)

Mackay and Brisbane, Queensland; Newcastle, New South Wales Felder's quotation of Assam as locality is undoubtedly one of his frequent errors.

135. *L. Pilcheri* Luc.

(*Calligenia Pilcheri* Luc., Proc. Linn. Soc. N. S. Wales, 1891, 279; *Epidictica Pilcheri* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 83.)

Rockhampton, Bundaberg, and Brisbane, Queensland, in November and March.

136. *L. calliphylla* Turn.

(*Epidictica calliphylla* Turn , Proc. Linn. Soc. N. S. Wales, 1903, 81.)

Brisbane, Queensland, in November.

137. *L. phoenodes* Feld.

(*Mieza phoenodes* Feld., Reis. Nov. pl. cxxxix., 37.)

Locality quoted as doubtfully Australian. Not known to me; it may not be referable to this genus.

138. *L. cristata* Butl.

(*Cyptasia cristata* Butl., Trans. Ent. Soc. Lond. 1886, 383; *Enaemia callianthes* Low., Trans. Roy. Soc. S. Austr. 1894, 111; *E. mixoleuca* Turn., Trans. Roy. Soc. S. Austr. 1900, 14.)

Mackay, Gayndah, and Gympie, Queensland.

139. *L. rutilella* Pag.

(*Enaemia rutilella* Pag., Zoologica xxix., 233.)

Bismarck Is.; not known to me.

140. *L. erythrocera* Feld.

(*Mieza erythrocera* Feld., Reis. Nov. pl. cxxxviii., 53.)

Cape York, Queensland; not known to me. Felder also figures from the same locality under the name of *Mieza picta* a species not known to me, but apparently more probably referable to the *Lithosiadae*.

141. *L. phlogopa* Meyr.

(*Enaemia* (?) *phlogopa* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, 258.)

Fly River, New Guinea.

142. *L. thiospila* Turn.

(*Epidictica thiospila* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 83.)

Mackay, Queensland.

143. *L. erythractis* Meyr.

(*Enaemia erythractis* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, 1043; *Lactura erythractis* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 86.)

Townsville and Bowen, Queensland, in January.

144. *L. parallela* Meyr.

(*Enaemia parallela* Meyr., Trans. Ent. Soc. Lond. 1889, 522; *Lactura eupoecila* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 86.)

New Guinea; Cooktown, Queensland.

145. *L. mactata* Feld.

(*Mieza mactata* Feld., Reis. Nov. pl. cxxxix., 44; *Lactura mactata* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 87.)

Cape York, Kuranda, and Geraldton, Queensland, in October and November.

23. Mieza Walk.

Differs from *Lactura* and *Anticrates* in having all the veins of hindwings separate and remote. *Hedycharis* Turn., is a synonym of this genus.

146. *M. phoenobapta* Turn.

(*Hedycharis phoenobapta* Turn., Proc. Linn. Soc. N. S. Wales, 1903, 90.)

Brisbane, Queensland, in March. Not known to me.

147. *M. leucophthalma*, n.sp.

♂. 20 mm. Head yellow, sides and back of crown suffused with crimson. Palpi and antennæ light yellowish Thorax yellow, posterior half pale crimson. Abdomen light rosy-ochreous. Forewings elongate, moderately broad, costa moderately arched, apex rounded, termen obliquely rounded; pale purplish-brown, becoming darker purple-fuscous towards margins of yellow markings; a rather irregular yellow streak all round costa and termen, margined internally with fiery-orange suffusion, and a similar spot on middle of dorsum; a roundish patch of white suffusion in disc above middle: cilia yellow, at tornus orange-tinged. Hindwings and cilia pale ochreous-rosy.

Cooktown, Queensland; one specimen.

148. *M. pyrilampis* Meyr.

(*Enaemia pyrilampis* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, 257.)

Fly River, New Guinea.

149. *M. colabristis*, n.sp.

♂. 23 mm. Head yellow, crown red except on sides. Palpi red, beneath pale yellowish. Antennæ ochreous, basal joint red. Thorax yellow, anterior edge of collar, angulated marks on middle of patagia connected by a streak on posterior edge of collar, and a dorsal streak starting from this and posteriorly furcate crimson-red. Abdomen coppery-orange. Forewings elongate, slightly dilated posteriorly, costa posteriorly gently arched, apex obtuse, termen obliquely rounded; 7 and 8 stalked; yellow, with longitudinal reddish-orange streaks between veins in disc and posteriorly, not reaching margins; markings bright crimson-red; a slender basal fascia, furcate costally, and connected with short

costal and dorsal streaks from base; a straight streak from $\frac{1}{3}$ of dorsum to middle of costa, and a parallel series of three marks between this and basal fascia; two posterior series of marks on veins, strongly angulated outwards in disc, towards dorsum becoming streaks connected by lines on veins, first rising from costal extremity of preceding streak and terminating on middle of dorsum, where it meets a bar from $\frac{2}{3}$ of preceding streak; terminal extremities of veins shortly crimson-red: cilia reddish-orange (imperfect). Hindwings and cilia orange, slightly rosy-tinged.

New Guinea; one specimen.

24. EREMOTHYRIS Wals.

Differs from *Anticrates* in having veins 6 and 7 of hindwings stalked *Epopsia* Turn., is a synonym of this.

150. *E. metreta* Turn.

(*Epopsia metreta* Turn., Proc.Linn.Soc.N.S.Wales, 1903, 90.)

Cooktown, Queensland. Not known to me; but I possess two examples of an *Anticrates* from Borneo which appear to agree exactly with all particulars of Dr. Turner's description except in the one distinguishing neural character; and as Dr. Turner's type was apparently unique, it is possible that it may be an abnormal individual, and in any case further information is desirable.

25. ANAPHANTIS, n.g.

Head with appressed scales; ocelli small; tongue developed. Antennæ $\frac{5}{6}$, thickened with smooth scales, basal joint without pecten. Labial palpi moderately long, curved, ascending, with appressed scales, terminal joint much shorter than second, pointed. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled. Forewings with 1*b* long-furcate, 2 from towards angle, 7 to apex (but indefinite), 11 from beyond middle. Hindwings 1, elongate-ovate, cilia $\frac{1}{6}$; 3 and 4 connate, 5-7 parallel.

Differs from *Anticrates* by the thickened antennæ.

151. *A. isochrysa*, n.sp.

♀. 17-18 mm. Head, palpi, and thorax blackish, collar orange. Antennæ blackish, apical third white. Abdomen orange, apical third blackish. Forewings elongate, costa moderately arched, apex rounded, termen very obliquely rounded; purplish-black; a broad direct transverse orange band, extending from $\frac{1}{5}$ to about $\frac{3}{5}$: cilia blackish. Hindwings orange; apical third black; cilia black, round dorsum and termen orange.

Bougainville, Solomon Is.; two specimens (Meek).

26. Hilarographa Z.

Head with loosely appressed hairs; ocelli large, bright; tongue short. Antennæ hardly over $\frac{1}{2}$, in ♂ strongly fasciculate-ciliated, basal joint stout, without pecten. Labial palpi moderate, slender, curved, ascending, with appressed scales, terminal joint shorter than second, tolerably pointed. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled. Forewings with 1*b* furcate, 2 from before $\frac{3}{4}$. 7 and 8 approximated or stalked, 7 to apex or termen, 8 sometimes to termen, 11 from before middle. Hindwings 1, oblong-ovate, cilia $\frac{1}{3}$; 3 and 4 short-stalked, 6 and 7 stalked.

Idiothauma Wals., and *Thaumatographa* Wals., are synonyms of this genus.

152. *H. pyranthis*, n.sp.

♂♀. 10-12 mm. Head orange suffused with grey, face light yellowish. Palpi pale ochreous, base of second and terminal joints dark fuscous. Antennæ brownish-ochreous. Thorax orange, with two leaden-blue stripes. Abdomen orange. Forewings triangular, costa posteriorly moderately arched, apex rounded, termen sinuate beneath apex, rather prominent in middle, rather oblique beneath; 7 and 8 stalked; bright reddish-orange; three narrow leaden-blue black-edged streaks from base to about $\frac{1}{3}$, subcostal curved downwards posteriorly, between subcostal and median a broader yellow streak; an oblique yellow spot from costa at $\frac{1}{3}$; median area occupied by about eight

strongly angulated transverse purple-black striæ, irregularly anastomosing especially in pairs so as to form a confused network, on costa reduced to five, outer pairs enclosing a leaden-blue mark; a sinuate leaden-blue black-edged streak from costa at $\frac{2}{3}$ to near apex, where it unites with a wedge-shaped white black-edged præapical mark on costa; a small triangular white spot on subapical sinuation, tipped with leaden-blue and edged with blackish; some irregular black marks before termen on lower half: cilia pale orange, on upper half of termen suffused with blackish, with a white spot on subapical sinuation, on costa white barred with black. Hindwings bright orange; a subterminal series of five partly confluent small black spots on upper $\frac{2}{3}$; cilia orange, on upper half of termen suffused with fuscous, with black basal line.

St. Aignan I., New Guinea; three specimens (Meek).

153. *H. zapyra* Meyr.

(*Hilarographa zapyra* Meyr., Trans. Ent. Soc. Lond. 1886, 286.)

Port Moresby, New Guinea.

27. Cebysa Walk.

Head with appressed hairs, collar in ♂ rough-haired; tongue absent. Antennæ $\frac{3}{5}$, in ♂ with very short pectinations terminating in fascicles of long cilia, in ♀ thickened with scales, especially towards $\frac{3}{4}$, basal joint short. Labial palpi extremely short, pointed, porrected, in ♂ with long rough hairs, in ♀ rough-scaled. Maxillary palpi absent. Posterior tibiæ short, smooth-scaled. Forewings with 1*b* long-furcate, 2 from near angle, 7 in ♂ to termen, in ♀ to apex, 8 absent, 10 from near angle, 11 from middle, secondary cell small, well-marked. Hindwings in ♂ 1, broad-ovate, cilia $\frac{1}{6}$, in ♀ $\frac{1}{2}$, elongate-ovate, cilia $\frac{1}{2}$; 2-4 parallel, 4 from angle, 5 approximated to 4, 6 and 7 in ♂ parallel, in ♀ stalked, 7 to apex.

A singular genus, which has hitherto been puzzling, but is certainly in its right place here. *Sezeris* Walk., is a synonym. The dissimilarity of the sexes is extraordinary.

154. *C. leucoteles* Walk.

(*Cebysa leucoteles* Walk., Bomb. 486 (-us), (♀); *Pitane dilecta* ib. 532 (♂), 959; *Sezeris conflictella* ib., Tin. 509; *Oecinea Scotti* Scott, Austr. Lep. 29, pl. ix., 4.)

♂. 15-16 mm. Head ochreous-yellow, mixed with dark fuscous except on forehead. Palpi pale yellowish. Antennæ yellow-ochreous ringed with dark fuscous. Thorax dark fuscous, with a pale yellow stripe on inner side of patagia. Abdomen dark fuscous, with segmental fringes of pale yellowish hairs. Forewings rather elongate-triangular, costa moderately arched, apex obtuse, termen obliquely rounded; dark purplish-fuscous, marked with numerous minute ochreous-yellow dots except on costal fourth; six small ochreous-yellow costal spots, last almost apical: cilia ochreous-yellow, basal half dark fuscous. Hindwings dark purplish-fuscous; an elongate ochreous-yellow blotch in disc from near base to ⅔, enlarged posteriorly; several small irregular ochreous-yellow spots between this and dorsum, and one at apex; cilia yellow, basal third dark fuscous except at apex.

♀. 12-18 mm. Head, palpi, antennæ, thorax, and abdomen shining blue-blackish. apex of antennæ white; abdomen elongate, tufted with hairs laterally. Forewings elongate, moderate, costa strongly arched, apex obtuse, termen obliquely rounded; shining deep blue; one or sometimes two light orange spots on costa towards middle, and sometimes a few scattered orange dots; a variable irregular light orange apical patch, extended on termen to tornus: cilia orange. Hindwings deep fuscous-purple: one or two small irregular yellow spots towards dorsum; an irregular pale orange apical patch, extending along termen to below middle; cilia pale orange, dark fuscous on dorsum and towards tornus.

Sydney, New South Wales; Melbourne, Victoria; from February to May, six specimens. Larva feeding in a portable case of silk covered with refuse on lichens on rocks. It seems likely that the conspicuous blue and orange tints of the ♀ are warning colours, possibly mimicking some wasp-like insect; observations on this would be interesting.

28. Piestoceros, n.g.

Head with appressed scales, sidetufts somewhat spreading; ocelli present; tongue developed. Antennæ $\frac{3}{4}$, strongly compressed, flat, above with a streak of rough scales throughout, basal joint short, without pecten. Labial palpi rather short, porrected, loosely scaled, terminal joint shorter than second, tolerably pointed. Maxillary palpi rudimentary. Posterior tibiæ with long hairs above. Forewings with 2 from near angle, 7 to termen, 8-10 from near 7, 11 from beyond middle. Hindwings under 1, elongate-ovate, cilia $\frac{3}{4}$; 2-7 tolerably parallel, 5 and 6 sometimes approximated, transverse vein oblique.

Although abnormal in some particulars, such as the long hairs of posterior tibiæ, this curious genus seems better placed here than anywhere else.

155. *P. conjunctella* Walk.

(*Incurvaria conjunctella* Walk. 491.)

♂♀. 13-15 mm. Head and thorax dark bronzy, sidetufts in ♂ yellowish. Palpi ochreous-yellow. Antennæ dark purplish-fuscous, apex and a median band whitish-yellowish. Abdomen bronzy-fuscous. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen slightly rounded, rather strongly oblique; purplish-coppery-bronze, sprinkled with black, and strewn throughout with fine linear whitish scales: a slender outwards-curved coppery-golden-metallic fascia beyond middle: cilia coppery-golden-metallic. Hindwings orange; apical $\frac{2}{5}$, and a narrow streak along termen to tornus dark fuscous; cilia fuscous, with darker basal shade.

Cairns, Townsville, and Brisbane, Queensland; Sydney, New South Wales; in November, February, and March, five specimens. Seems to frequent *Acacia*.

29. Epicroesa, n.g.

Head smooth, metallic; ocelli present; tongue developed. Antennæ over 1, filiform or somewhat flattened, in ♂ simple, basal joint moderately elongate, without pecten. Labial palpi short,

porrected, filiform, pointed. Maxillary palpi rudimentary. Posterior tibiæ and basal joint of tarsi with rough projecting scales above. Forewings with 2 from near angle, 4 absent, 7 to termen, 11 from beyond middle. Hindwings ½, trapezoidal-lanceolate, cilia 2; cell open between 3 and 4, 2 and 3 forming short branches of lower median, 4-7 appearing as branches of upper median, or 5 sometimes absent.

Type *E. ambrosia*. This is another curious genus, distinguished from its allies by the antennæ being longer than forewings; the species are very brilliantly coloured.

1. Forewings with a metallic streak parallel to termen.. ... 156. *thiasarcha*.
   Forewings without such streak.
2. Forewings with golden-metallic costal spots at ⅛ and ⅗.. 157. *ambrosia*.
   Forewings without such spots......... .... 158. *metallifera*.

156. *E. thiasarcha*, n.sp.

♂♀. 7-9 mm. Head shining bronze with green reflections. Palpi yellowish. Antennæ distinctly flattened, dark purple-fuscous, basal joint greenish-bronze. Thorax metallic green-blue. Abdomen dark bluish-fuscous. Forewings elongate, costa posteriorly moderately arched, apex obtuse, termen and dorsum gently and continuously rounded; brilliant metallic green-blue; an orange black-edged fascia near base, in ♂ narrow and suffused with black towards costa, in ♀ crossed by several longitudinal black lines; a violet-silvery-metallic transverse spot on costa immediately beyond this, and another beyond middle, edged posteriorly by a black line crossing wing to ⅗ of dorsum, costal area between these suffused with blackish; apical area beyond this line orange, including several violet-silvery-metallic partly black-edged markings, viz., an erect triangular mark before tornus, a longitudinal curved streak parallel to termen, and two costal marks, in ♂ confluent into a triangular costal spot: cilia fuscous, with blackish basal line. Hindwings almost lanceolate, more pointed than in the other species, vein 5 present; blackish-fuscous; cilia dark fuscous.

Cairns, Queensland, in September and October; two specimens (*Dodd*).

157. *E. ambrosia*, n.sp.

♂♀. 9-11 mm. Head bright metallic bronze, collar yellowish. Palpi ochreous-yellow. Antennæ hardly flattened, dark fuscous, basal joint yellow. Thorax metallic bronze, with green and coppery reflections. Abdomen dark fuscous. Forewings elongate, costa anteriorly faintly sinuate, moderately arched posteriorly, apex obtuse, termen and dorsum continuously rounded; brilliant coppery-purple-bronze; an orange basal patch, marked at base with some black and metallic green scales, at base of costa with a black dot, preceded and followed by metallic bronze dots, outer edge straight; a violet-golden-metallic dot on costa at $\frac{1}{3}$, edged with black anteriorly, and followed by a small semioval black spot; a small transverse golden-metallic spot on costa at $\frac{2}{3}$, preceded by a transverse black spot, and followed by a smaller black spot, whence proceeds an oblique black line to termen above middle, preceded in middle by a triangular black spot, and beneath this by some violet-golden suffusion; a patch of metallic blue-green scales towards middle of dorsum; apical area beyond the oblique black line orange, cut by a violet-metallic black-edged streak parallel to the black line: cilia dark fuscous, towards tornus mixed with metallic-bronzy, tips pale grey. Hindwings and cilia dark fuscous; vein 5 present.

Cairns, Queensland, in September and October (Dodd); three specimens.

158. *E. metallifera*, n.sp.

♀. 8 mm. Head bright bronzy-metallic, face light metallic-blue. Palpi yellow. Antennæ hardly flattened, dark fuscous, towards base deep yellow. Thorax metallic bronze. Abdomen dark bronzy-fuscous. Forewings more pointed than in *ambrosia*; shining bronzy-purple, with green reflections; an orange basal patch, enclosing a metallic green-blue basal spot in middle, outer edge straight; two small semioval black spots on costa before and beyond middle; an oblique black line from $\frac{3}{4}$ of costa to termen above middle; apical area beyond this orange, cut by an irregular violet-metallic black-edged streak parallel to the line: cilia dark

fuscous, on lower half of termen mixed with coppery-bronze, tips pale grey. Hindwings and cilia dark fuscous; vein 5 absent.

Duaringa, Queensland (Lower); one specimen.

30. Tortyra Walk.

Head smooth, with postorbital cilia; ocelli present; tongue developed. Antennæ $\frac{2}{3}$, thickened with scales except towards apex, in ♂ serrate, ciliated, basal joint moderate, without pecten. Labial palpi moderate, curved, ascending, smooth-scaled, terminal joint shorter than second, obtuse. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled above, sometimes with expansible whorls of scales on origin of spurs. Forewings with 1*b* furcate, 2 from $\frac{2}{3}$, 3 from angle, 7 to termen, 9 and 10 from near 8, 11 from before middle, secondary cell defined. Hindwings 1 or over 1, ovate-triangular, cilia $\frac{1}{6}$-$\frac{1}{8}$; 3 and 4 stalked, 5-7 parallel, 8 approximated to cell in middle.

A genus of limited extent but ranging through the tropics of the Old and New World. *Saptha* Walk., *Badera* Walk., and *Choregia* Z., are synonyms. The species are brilliantly metallic, but often very similar, and require careful discrimination.

1. Metallic transverse postmedian streak entire	2.
Metallic transverse postmedian streak reduced to one or two patches	3.
2. Violet-coppery species, hindwings with yellow band	162. *divitiosa*.
Brassy-green species, hindwings without yellow band	161. *prasochalca*.
3. Forewings with metallic-blue postmedian spot beneath middle	4.
Forewings without such spot	163. *prodigella*.
4. Hindwings with yellow band	159. *iridopa*.
Hindwings without yellow band	160. *paradelpha*.

159. *T. iridopa*, n.sp.

♀. 18-20 mm. Head and palpi metallic blue-green. Antennæ purple-black, with white band about $\frac{3}{4}$. Thorax blackish, with three metallic iridescent-green stripes. Abdomen blackish, ringed with deep bronze. Forewings elongate-triangular, costa posteriorly moderately arched, apex rounded, termen rather oblique,

hardly rounded; deep bronze; four metallic iridescent-green black-edged streaks, first along basal fourth of costa, second from base above submedian fold, abruptly curved to dorsum at $\frac{2}{5}$, third subdorsal from base to about $\frac{1}{4}$, fourth direct from costa at $\frac{2}{5}$ to submedian fold, attenuated downwards; a purple-black postmedian fascia, anterior edge straight, well-defined, running from middle of costa to middle of dorsum, posterior edge merged in a purple-black suffusion which extends over most of posterior area of wing; on this fascia near anterior edge are two large brilliant metallic-blue spots above and below middle, upper followed by a longitudinal bright brassy-golden patch; a broad suffused bright brassy-golden terminal fascia, preceded by some similar irroration: cilia shining whitish-bronze, basal third black. Hindwings blackish; base and dorsal and subdorsal streaks not reaching termen hyaline whitish; an irregular rather broad light ochreous-yellow streak from base to middle of disc, thence curved upwards to beneath costa at $\frac{3}{4}$; cilia whitish, basal third blackish.

Florida, Solomon Is. (Meek); two specimens.

160. *T. paradelpha*, n.sp.

♂♀. 19-20 mm. Differs from *iridopa* only as follows: forewings with brassy-golden irroration on posterior half more developed, forming numerous distinct longitudinal lines; cilia light shining violet-bronze, with black basal line: hindwings dark fuscous, wholly without yellow streak, cilia in ♂ suffused with pale fuscous. Forewings in ♂ with termen more oblique than in ♀; hindwings with tornus broadly expanded.

Treasury Island, Solomon Is. (Meek); two specimens.

161. *T. prasochalca*, n.sp.

♂♀. 19-22 mm. Head dark metallic blue-bronze, face metallic blue-green. Palpi metallic greenish-bronze, towards apex blackish. Antennæ purple-blackish, with an ochreous-white band at $\frac{2}{3}$. Thorax dark fuscous, with three metallic coppery-green stripes. Abdomen fuscous, in ♂ with expansible genital tuft of pale fuscous and whitish hairs. Forewings elongate-triangular, costa

almost straight, posteriorly moderately arched, apex obtuse, termen rather obliquely rounded; deep golden-bronze; three metallic-green, partially black-edged streaks from base, first along costa to $\frac{1}{4}$, second to $\frac{1}{4}$ of disc, thence curved to dorsum at $\frac{2}{5}$, third subdorsal to $\frac{1}{4}$, and another from costa beyond $\frac{1}{3}$ reaching half across wing; a metallic brassy-golden streak, edged anteriorly with purple-black, from middle of dorsum to near middle of costa, thence bent beneath costa to near $\frac{3}{4}$; above and beyond this streak the whole wing is purple-blackish sprinkled with fine pale golden-metallic scales, except a broad terminal fascia of groundcolour densely irrorated with metallic brassy-golden: cilia pale violet-blue-fuscous, with blackish basal line. Hindwings in ♂ broader than in ♀, tornus not produced, with a transparent almost dorsal groove; fuscous, on upper portion of termen with a more or less defined broad dark fuscous band; sometimes a small undefined paler or fuscous-whitish patch beneath costa beyond middle; cilia light fuscous, tips whitish, with dark fuscous basal line.

New Britain, Bismarck Is.; Choiseul, Guadalcanar, Solomon Is.; seven specimens (Meek).

162. *T. divitiosa* Walk.

(*Saptha divitiosa* Walk., 1015; *Badera nobilis* Feld., Reis. Nov. pl. cxxxix., 9.)

♂♀. 18-21 mm. Head metallic green-blue, with a pale yellowish patch behind eyes. Antennæ purple-black, with ochreous-white band about $\frac{3}{4}$. Thorax blackish, with three metallic-green stripes. Forewings with termen obliquely rounded; deep bronze; four metallic-green streaks on basal area, as in *prasochalca*; a curved metallic blue-green streak from middle of dorsum to beneath costa at $\frac{3}{5}$, edged anteriorly with blackish and posteriorly with metallic violet-coppery; beyond this the wing is wholly suffused with purple-blackish, thinly strewn with golden-metallic scales, except a broad metallic violet-coppery terminal fascia: cilia pale purplish-bronze, with blackish basal line. Hindwings in ♂ with tornus expanded and more strongly prominent than in

prasochalca; blackish; partially confluent dorsal and subdorsal hyaline streaks, not reaching termen; a curved yellow streak from base to middle of disc, thence dilated and curved to beneath costa at $\frac{3}{4}$, in ♂ hyaline except towards posterior extremity, and largely confluent with subdorsal and dorsal streaks towards base; cilia fuscous-whitish, with blackish basal line.

St. Aignan, Woodlark, and Sudest Islands, New Guinea (Meek); also recorded from Ceram and Amboina; eight specimens.

163. *T. prodigella* Walk.

(*Badera prodigella* Walk., Suppl. 1820.)

♂♀. 18-21 mm. Head dark bluish-bronze, face metallic blue-green, a patch behind eye ochreous-yellow. Antennæ purple-black, with white band at $\frac{3}{4}$. Thorax blackish-bronze, with three metallic-green stripes. Forewings with termen obliquely rounded, in ♀ less oblique; very deep bronze; four metallic iridescent-green stripes on basal area, as in *prasochalca;* posterior half beyond a straight line from middle of costa to middle of dorsum suffused with purple-blackish; an elongate metallic violet-golden patch beneath costa beyond middle, edged anteriorly with metallic blue; posterior area thinly strewn with metallic violet-golden scales; a suffused metallic violet-golden terminal fascia: cilia bronzy-grey, with blackish basal line. Hindwings in ♂ with tornus somewhat expanded, little prominent; blackish; dorsal and subdorsal hyaline streaks not reaching termen; an ochreous-yellow stripe from base to middle of disc, thence irregularly expanded and curved to beneath costa at $\frac{3}{4}$; cilia pale fuscous, becoming whitish round apex, with blackish basal line.

Cairns, Queensland (Barnard, Dodd); also recorded from Java; six specimens.

31. MISCERA Walk.

Head with loosely appressed scales; ocelli present; tongue developed. Antennæ $\frac{2}{3}$, in ♂ unipectinated, in ♀ roughened with scales, basal joint short, without pecten. Labial palpi moderate, obliquely ascending or porrected, thickened with scales,

second joint more or less rough or hairy beneath, terminal joint short, obtuse or somewhat pointed. Maxillary palpi obsolete Posterior tibiæ rough-scaled above Forewings with 1*b* long-furcate, 2-4 approximated from angle, 7 to apex, 8-10 from near 7 11 from middle, no secondary cell. Hindwings over 1, ovate, cilia $\frac{1}{4}$-$\frac{1}{3}$; 3 and 4 connate or stalked, 5-7 parallel.

This genus is the Australian representative of the European *Brachodes* (formerly better known as *Atychia*), with which it agrees in all structural and superficial characteristics except the neuration of hindwings, which is quite different: in *Brachodes* veins 2 and 3 are closely approximated or connate, 3 and 4 remote and parallel, whilst in *Miscera* 2 and 3 are remote, 3 and 4 connate; as the latter is the normal structure of the *Simaethis* and *Tortyra* groups, I infer that *Miscera* is more ancestral than *Brachodes*.

1. Forewings with whitish streak from base	169. *episcota*.
Forewings without such streak	2.
2. Hindwings marked with yellow or white	3.
Hindwings wholly fuscous	173. *omichleutis*.
3. Palpi with long rough hairs	167. *mesochrysa*.
Palpi at most with short scales	4.
4. Hindwings yellow, with base and terminal fascia dark fuscous	5.
Hindwings dark fuscous, with white or yellow markings	6.
5. Forewings dark fuscous, with whitish-ochreous discal spot	165. *resumptana*.
Forewings light fuscous, without discal spot	171. *holodisca*.
6. Hindwings with yellowish fascia only	7.
Hindwings with one or more separate spots	8.
7. Forewings obviously dilated, not whitish-sprinkled	170. *centropis*.
Forewings hardly dilated, whitish-sprinkled	166. *orthaula*.
8. Hindwings with white anterior fascia and median subcostal spot	164. *leucopis*.
Hindwings with series of three whitish or yellowish spots	9.
9. Abdomen with pale rings throughout, spots of hindwings obscure	172. *micrastra*.
Abdomen without pale rings on basal half, spots well-marked	168. *desmotoma*.

164. *M. leucopis*, n.sp.

♀. 13 mm. Head, antennæ, and thorax dark fuscous. Palpi fuscous, becoming white beneath and towards base. Abdomen dark fuscous, base and three narrow rings beyond middle white. Forewings elongate, rather dilated posteriorly, costa nearly straight, apex rounded, termen obliquely rounded; fuscous, mixed with dark fuscous and some whitish scales; an indistinct small transverse white spot in disc beyond middle: cilia fuscous, base mixed with dark fuscous. Hindwings blackish-fuscous; a moderately broad white fascia from middle of dorsum towards costa at $\frac{1}{3}$, becoming obsolete before reaching it; a rather large white spot beneath middle of costa; cilia light fuscous, base mixed with dark fuscous.

Duaringa, Queensland (Barnard); one specimen.

165. *M. resumptana* Walk.

(*Miscera resumptana* Walk., 458; *Atychia anthomera* Low., Trans. Roy. Soc. S. Austr. 1896, 162.)

♂. 14-15 mm. Head, palpi, and thorax dark fuscous, finely sprinkled with white. Antennæ dark fuscous, pectinations $2\frac{1}{2}$. Abdomen dark fuscous, with one subbasal and four posterior narrow pale yellowish rings. Forewings elongate, somewhat dilated posteriorly, costa nearly straight, apex rounded, termen obliquely rounded; dark fuscous finely irrorated with ochreous-whitish; a whitish-ochreous spot in disc beyond middle: cilia dark fuscous mixed with whitish-ochreous. Hindwings deep yellow; base dark fuscous; a broad rather irregular dark fuscous terminal fascia; cilia light yellow, basal third dark fuscous, sometimes more or less wholly suffused with dark grey.

Duaringa and Rockhampton, Queensland, in April (Barnard); three specimens. It is possible that this and *leucopis* are sexes of the same species, but I cannot venture to unite them.

166. *M. orthaula*, n.sp.

♂. 16 mm. Head, palpi, and thorax dark fuscous, finely sprinkled with whitish; palpi short-scaled, whitish beneath.

Antennæ dark fuscous, pectinations 2½. Abdomen dark fuscous, with five slender pale yellowish rings. Forewings elongate, posteriorly somewhat dilated, costa nearly straight, apex rounded-obtuse, termen rather obliquely rounded; dark fuscous, irregularly sprinkled with whitish, the irroration indicating a very undefined discal spot beyond middle: cilia dark fuscous, tips of scales fuscous-whitish. Hindwings blackish-fuscous, slightly purplish-tinged; a moderate irregular whitish-ochreous antemedian fascia, outer edge irregularly prominent above middle; cilia whitish-yellowish, basal third dark fuscous.

Duaringa, Queensland (Barnard); one specimen. Considerably broader-winged than the preceding, with the yellow area of the hindwings much reduced.

167. *M. mesochrysa* Low.

(*Atychia mesochrysa* Low., Trans. Roy. Soc. S. Austr. 1903, 68.)

♂. 17-18 mm. Head, palpi, and thorax dark fuscous, very finely whitish-sprinkled; palpi white beneath, with long rough projecting hairs. Antennæ dark fuscous, pectinations 6. Abdomen dark fuscous, with six narrow yellow rings. Forewings elongate, posteriorly dilated, costa slightly arched, apex rounded-obtuse, termen rather obliquely rounded; dark fuscous, suffusedly mixed with very long ochreous-brown scales; a somewhat incurved narrow streak of whitish irroration from dorsum beyond middle to disc at ¾, reaching half across wing: cilia fuscous. Hindwings blackish; a moderate irregular orange-yellow median fascia, broadest towards costa, not quite reaching dorsum, outer edge angularly prominent above and below middle; cilia blackish grey, basal line blackish, tips yellow-whitish, towards tornus becoming wholly yellowish.

Geraldton and Perth, West Australia, in October and November; three specimens. Differs from all the other species by the much longer antennal pectinations, and the long rough hairs of palpi.

168. *M. desmotoma* Low.

(*Atychia desmotoma* Low., Trans. Roy. Soc. S. Austr. 1896, 162.)

♂. 17-21 mm. Head and thorax rather dark fuscous. Palpi fuscous, becoming whitish beneath and towards base. Antennæ dark fuscous, pectinations 3. Abdomen dark fuscous, beyond middle with four slender pale yellowish rings, apex yellowish. Forewings elongate, posteriorly dilated, costa slightly arched, apex rounded-obtuse, termen somewhat obliquely rounded; dark fuscous; a small ochreous-whitish narrow transverse discal spot beyond middle; an indistinct posteriorly suffused whitish streak from beneath this to dorsum beyond middle: cilia fuscous, towards base dark fuscous. Hindwings blackish; an antemedian series of three irregular ochreous-white or pale yellowish spots, two lower sometimes nearly confluent; cilia pale ochreous yellow, basal third blackish.

Blackheath (3500 feet), New South Wales; Melbourne and Cheltenham, Victoria; in December and January, three specimens.

169. *M. episcota* Low.

(*Atychia episcota* Low., Trans. Roy Soc. S. Austr. 1903, 68.)

Henley Beach, South Australia. Not known to me.

170. *M. centropus*, n.sp.

♂. 21 mm. Head, palpi, and thorax dark fuscous, very finely sprinkled with whitish, palpi white beneath, shortly rough-scaled. Antennæ dark fuscous, pectinations 3. Abdomen dark fuscous, with six narrow ochreous-yellow rings. Forewings elongate, posteriorly dilated, costa nearly straight, apex rounded-obtuse, termen somewhat obliquely rounded; dark fuscous; a small whitish spot in disc beyond middle: cilia dark fuscous, tips whitish. Hindwings purple-blackish; a moderate irregular deep yellow antemedian fascia, not quite reaching dorsum, outer edge irregularly prominent above middle; cilia ochreous-yellow, basal third dark fuscous, tips whitish.

Perth, West Australia, in November; one specimen.

171. *M. holodisca*, n.sp.

♂. 16 mm. Head, palpi, and thorax pale ochreous-grey, face more whitish, palpi beneath whitish. Antennæ dark fuscous, pectinations 3. Abdomen grey, with seven slender ochreous-whitish rings. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen obliquely rounded; light fuscous, with prismatic reflections, irregularly sprinkled with white: cilia pale whitish-fuscous mixed with fuscous. Hindwings light ochreous-yellow; base suffused with grey; a moderate fuscous fascia round apex and along termen, becoming narrow near tornus; cilia fuscous, becoming pale ochreous-yellow round tornus.

Geraldton, West Australia, in November; one specimen.

172. *M. micrastra*, n.sp.

♂. 14-17 mm. Head fuscous, face whitish-tinged. Palpi whitish, towards apex infuscated. Antennæ dark fuscous, pectinations 2. Thorax dark fuscous, sometimes mixed with ochreous. Abdomen dark fuscous, with six or seven narrow ochreous-whitish rings. Forewings elongate, posteriorly dilated, costa slightly arched, apex rounded-obtuse, termen rather obliquely rounded; dark fuscous, suffusedly mixed with very long brownish-ochreous scales; undefined marks of ochreous-grey-whitish suffusion on or towards costa at $\frac{2}{5}$, and dorsum in middle; an ochreous-whitish discal dot at $\frac{2}{3}$, sometimes obsolete: cilia fuscous, sometimes with a few whitish scales. Hindwings blackish, slightly purple-tinged; an antemedian series of three small irregular white or light ochreous-yellow spots; cilia yellow-whitish, basal half suffusedly mixed with grey.

York and Perth, West Australia, in October and November; two specimens.

173. *M. omichleutis*, n.sp.

♂. 19-23 mm. Head, palpi, and thorax dark fuscous finely irrorated with white, palpi white beneath. Antennæ rather dark fuscous, pectinations 3. Abdomen fuscous. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen

obliquely rounded; fuscous, sometimes more or less strongly ochreous-tinged, sometimes variably sprinkled with whitish: cilia fuscous. Hindwings rather light ochreous-fuscous, becoming dark fuscous posteriorly; cilia light fuscous, darker at base, tips whitish.

Bathurst, New South Wales; Mount Lofty, South Australia; in November, February, and March, six specimens

32. IMMA Walk.

I have recently set forth an account of this interesting tropical genus in the Transactions of the Entomological Society of London for 1906, pp.169-206, and therefore only give a list of the Australian species here.

174. *I. autodoxa* Meyr.

Fiji.

175. *I. atrosignata* Feld.

Amboina.

176. *I. transversella* Snell.

New Guinea; ranging also to Java and Singapore. *Tortricomorpha obliquifasciata* Wals., is a synonym.

177. *I. albifasciella* Pag.

Duaringa, Queensland; Bismarck Is. *Tortricomorpha monodesma* Low., is a synonym.

178. *I. acosma* Turn.

Brisbane, Queensland; in September, January, and May.

179. *I. congrualis* Wals.

New Guinea, Halmahera.

180. *I. marileutis* Meyr.

Duaringa, Queensland; also from South Australia.

181. *I. leiochroa* Low.

Brisbane, Queensland.

182. *I. psithyristis* Meyr.

Solomon Is.

183. *I. costipuncta* Feld.

Amboina.

184. *I. aulonias* Meyr.

Solomon Is.

185. *I. bilineella* Snell.

Bismarck Is., Buru; also from Celebes and Sangir.

186. *I. diaphana* Pag.

(*Tortricomorpha diaphana*, Pag., J B. Nass. Ver. 1884, 290, pl. vi. 12.)

Amboina.

187. *I. thyriditis* Meyr.

Solomon Is.

188. *I. dioptrias* Meyr.

New Guinea.

189. *I. penthinoides* Pag.

(*Tortricomorpha penthinoides* Pag., J B. Nass. Ver. 1884, 291.)

Amboina. This species and *I. diaphana* were omitted from my paper as quoted.

190. *I. viola* Pag.

Aru.

191. *I. grammatistis* Meyr.

New Guinea.

192. *I. minatrix* Meyr.

New Guinea.

193. *I. hemixanthella* Holl.

Buru.

194. *I. crocozela* Meyr.

New Guinea.

195. *I. chrysoplaca* Meyr.

New Guinea.

196. *I. epicomia* Meyr.

Solomon Is.

197. *I. stilbiota* Low.

Duaringa, Queensland

198. *I. lichenopa* Low.

Cooktown, Queensland.

[33. LOXOTROCHIS Meyr.

199. *L. sepias* Meyr.

(*Loxotrochis sepias* Meyr., Trans. Ent. Soc. Lond. 1906, 205.)

Sir George Hampson informs me that this was erroneously assigned to the New Hebrides; its real locality is the province of Espirito Santo, in Brazil.]

34. BRENTHIA Clem.

Differs from *Simaethis* and *Choreutis* by the labial palpi, which are pointed, without tuft; in *Simaethis* they are obtuse or truncate, in *Choreutis* they are pointed, but the second joint is tufted with hairs beneath.

200. *B. quadriforella* Z.

(*Brenthia quadriforella* Z., Hor. Ross. 1877, 172, pl. ii., 61; *Simaethis hypocalla* Low., Trans. Roy. Soc. S. Austr. 1905, 113.)

North Queensland, New Guinea.

201. *B. trilitha*, n.sp.

♂. 10 mm. Head and thorax bronzy-fuscous. Palpi whitish, terminal joint with base and anterior edge fuscous. Antennæ whitish ringed with dark fuscous, ciliations 1½. Abdomen dark fuscous, segmental margins whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, termen somewhat rounded, little oblique; bronzy-fuscous, irrorated with whitish except on basal area; edge of basal area straight, somewhat darker-suffused; a round darker fuscous discal spot beyond middle, crossed by two transverse white bars; a terminal light bronzy-ochreous fascia, almost wholly occupied by three large black spots, each marked with two or three violet-metallic dots: cilia bronzy-fuscous. Hindwings with termen bent in middle; rather dark fuscous; a roundish white spot in middle of disc; a straight whitish subterminal line, not reaching costa or dorsum; between this and termen a violet-golden-metallic line on costal half; cilia whitish, with dark fuscous basal and apical shades.

New Georgia, Solomon Is. (Meek); one specimen.

202. *B. hecataea*, n.sp.

♂♀. 11-12 mm. Head, thorax, and abdomen rather dark bronzy-fuscous. Palpi whitish, two rings of second joint, and base and anterior edge of terminal joint fuscous. Antennæ whitish ringed with dark fuscous, ciliations in ♂ 3. Forewings elongate-triangular, costa slightly arched, apex rounded, termen almost vertical, slightly rounded; dark bronzy-fuscous; a straight cloudy whitish fascia before ¼, hardly reaching costa; some scattered golden-metallic scales towards costa before middle; a transverse-oval whitish spot in disc beyond middle; a cloudy whitish dot on dorsum before tornus; a transverse whitish mark towards termen in middle; a narrow suffused blackish terminal fascia, marked with seven pale violet-golden-metallic dots: cilia fuscous, with a darker median shade. Hindwings dark fuscous; a longitudinally elongate whitish spot in middle of disc; a straight whitish subterminal line, becoming obsolete towards margins; a violet-metallic line before termen, obtusely angulated so as to touch termen in middle; cilia fuscous, with darker subbasal shade, below middle with an oblique whitish patch.

St. Aignan I., New Guinea (Meek); two specimens.

35. Choreutis Hb.

203. *C. bjerkandrella* Thnb.

(*Choreutis bjerkandrella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 215.)

Duaringa, Brisbane, and Toowoomba, Queensland; Murrurundi, Sydney, Blackheath, and Shoalhaven, New South Wales; Melbourne and Warragul, Victoria; Adelaide, South Australia; from September to March, common. Widely distributed through most of the globe.

204. *C. homotypa*, n.sp.

♂♀. 9-12 mm. Head and thorax dark bronzy-fuscous, with a few white scales. Palpi dark fuscous mixed with white. Antennæ white ringed with black. Abdomen dark bronzy-fuscous, segmental margins whitish. Forewings rather elongate, posteriorly

dilated, costa gently arched, apex obtuse, termen sinuate, oblique; blackish-fuscous mixed with bronzy-brown; basal area finely sprinkled with white, outer edge angulated near costa; first line represented by a broad double fascia of white irroration, forming a white dot on costa at $\frac{2}{5}$; a transverse silvery-white mark in disc at $\frac{3}{5}$, and another on dorsum at $\frac{2}{3}$; a rather irregular silvery-white line from a white dot on costa at $\frac{3}{5}$ to dorsum before tornus, usually more or less interrupted; a fascia of whitish irroration from a white dot on costa at $\frac{4}{5}$ to tornus; a row of silvery-metallic marks surrounded with black round apex and termen: cilia whitish, round apex and below middle of termen suffused with dark grey, basal third tawny-bronze limited by a blackish shade. Hindwings rather dark fuscous, becoming darker posteriorly; a white line from disc at $\frac{3}{4}$ to tornus; cilia fuscous-whitish, with dark fuscous basal shade.

Mount Kosciusko (5000 feet), New South Wales; Gisborne, Victoria; Deloraine, George's Bay, and Hobart, Tasmania; from November to January, and in April, fourteen specimens.

205. *C. lampadias*, n.sp.

♂♀. 12-16 mm. Head and thorax tawny-bronze, more or less irrorated with white. Palpi grey mixed with white and black. Antennæ white ringed with black. Abdomen light bronze, segmental margins white. Forewings rather elongate, rather dilated posteriorly, costa gently arched, apex obtuse, termen sinuate, oblique; light tawny-bronze, more or less mixed with dark fuscous; a basal patch of white irroration, sometimes small; a somewhat curved whitish fascia from $\frac{1}{4}$ of costa to $\frac{2}{5}$ of dorsum; an indistinct line of whitish irroration from a white dot on middle of costa to a silvery-white mark on dorsum at $\frac{2}{3}$; a silvery-metallic transverse sometimes interrupted mark in disc at $\frac{2}{3}$, more or less surrounded with black scales; a silvery mark from a white dot on costa above this, and an oblique silvery mark below it; a straight whitish fascia from a white spot on costa at $\frac{4}{5}$ to tornus; an almost marginal silvery-metallic streak before termen throughout, preceded by some black scales: cilia whitish, with a blackish

basal line; and indications of a grey median shade sometimes reduced to three patches. Hindwings grey, sometimes darker posteriorly; a white streak from disc at $\frac{3}{4}$ to tornus, and indistinct traces of a second streak beyond this; cilia whitish, with dark fuscous basal and fuscous median shades.

Mount Kosciusko (5500 feet), New South Wales; Deloraine and Hobart, Tasmania; from November to January, twenty specimens.

36. SIMAETHIS Leach.

206. *S. basalis* Feld.

(*Simaethis basalis* Feld., Reis. Nov. pl. cxxxviii., 19; *S. chionodesma* Low., Trans. Roy. Soc. S. Austr. 1896, 167.)

Rockhampton and Brisbane, Queensland, in December and January; Aru; Amboina. Varies considerably in presence or absence of orange suffusion in hindwings and on terminal area of forewings.

207. *S. limonias*, n.sp.

♂. 14-15 mm. Head and thorax ochreous-orange, thorax with a central transverse dark fuscous band. Palpi orange, second and terminal joints with basal and subapical dark fuscous rings. Antennæ white ringed with black. Abdomen dark fuscous mixed with orange, anal tuft orange. Posterior legs orange banded with black, basal joint of tarsi rough-scaled above, third joint snow-white above. Forewings triangular, costa gently arched, apex obtuse, termen slightly rounded, rather oblique, sinuate above tornus; blackish-fuscous, markings ochreous-orange; two straight fasciæ near base; first line broad, straight, from a whitish dot on costa at $\frac{1}{4}$ to $\frac{1}{3}$ of dorsum, closely followed by a narrow rather irregular line; a transverse-oval discal spot beyond middle; second line moderate, rather irregular, from a whitish dot on costa at $\frac{3}{5}$ to $\frac{3}{4}$ of dorsum, curved outwards round discal spot, not touching it, with a short dentation outwards below middle, separated by a fine line of groundcolour from a broader uneven streak following it; terminal area more or less irrorated with ochreous-orange: cilia grey, with a blackish basal line. Hind-

wings dark fuscous; longitudinal median and submedian streaks of orange suffusion from base to $\frac{2}{3}$, more or less expanded at posterior extremity; sometimes a suffused orange streak along lower half of termen; cilia as in forewings.

Cairns, Queensland (Barnard); Woodlark Island (Meek); two specimens. Attention may be directed to the good specific characters furnished in this genus by the posterior tarsi, which are often distinctively decorated. In order to understand the complex markings of the forewings it is necessary to assume the blackish tint to be the ground, even when, as in the present species, the orange occupies the greater portion of the wings.

208. *S. sycopola* Meyr.

(*Simaethis sycopola* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 211.)

Brisbane, Queensland; Sydney, New South Wales; from March to May. Larva in folded leaves of *Ficus stipulata*.

209. *S. regularis* Pag.

(*Simaethis regularis* Pag., JB. Nass. Ver. 1884, 288.)

Amboina. This and some other of Pagenstecher's species are in my judgment too loosely described to be identified, and I cannot determine them.

210. *S. sessilis* Pag.

(*Simaethis sessilis* Pag., JB. Nass. Ver. 1886, 179.)

New Guinea. Not known to me.

211. *S. parva* Pag.

(*Simaethis parva* Pag., JB. Nass. Ver. 1884, 288.)

Amboina. Not known to me. *S. taprobanes* Z., is also quoted by Pagenstecher from Amboina and Aru; it is a well-known Ceylon species, and it seems more probable that the identification was mistaken.

212. *S. submarginalis* Walk.

(*Herbula submarginalis* Walk., Suppl. 1286; *H. multiferalis* ib., 1286.)

Ceram. I have seen this species, but do not possess it.

213. *S. ophiosema* Low.

(*Simaethis ophiosema* Low., Trans. Roy. Soc. S. Austr. 1896, 167.)

Townsville and Rockhampton, Queensland, in November, December, February, and May. Posterior tarsi with basal joint rough-scaled, blackish with white tip, second joint yellow-ochreous with white tip, other three black.

214. *S. lutescens* Feld.

(*Simaethis lutescens* Feld., Reis. Nov. pl. cxxxviii, 16.)

Amboina. Not known to me.

215. *S. cyanotoxa*, n.sp.

♀. 16 mm. Head and thorax ochreous-orange, thorax with central transverse blackish bar, posteriorly infuscated. Palpi orange, second and terminal joints with basal and subapical blackish rings. Antennæ whitish ringed with black. Abdomen dark fuscous mixed with brownish-orange, apex deep orange. Posterior legs orange banded with blackish, tibiæ and basal joint of tarsi rough-scaled above, third joint of tarsi snow-white above. Forewings triangular, costa gently arched, apex obtuse, termen gently rounded, rather oblique; black; an almost basal ochreous-orange fascia and line immediately following, angulated near costa; first line steel-blue edged with orange, from $\frac{1}{3}$ of costa to $\frac{1}{3}$ of dorsum, angulated above middle; immediately beyond this an irregular line of orange-ochreous suffusion, acutely angulated in middle; an oblique steel-blue discal mark beyond middle, surrounded with ochreous-orange; second line steel-blue edged with orange, widely broken inwards below middle, upper portion evenly curved, lower inwardly oblique, the two portions connected by a fine orange line; this is very closely followed throughout by

an uneven ochreous-orange streak, attenuated above middle and beneath break; terminal area with some scattered ochreous-orange scales, and a roundish spot towards termen beneath apex: cilia leaden-grey, with a black basal line mixed with orange, tips grey-whitish. Hindwings dark fuscous; an orange median streak from base, and indications of subdorsal and dorsal streaks, all terminated in a postmedian transverse orange streak not reaching costa; orange spots on termen in middle and above tornus; cilia ochreous-whitish, with blackish basal line, round tornus grey.

Isabel Island, Solomon Is.; one specimen (Meek).

216. *S. a-caeruleum* Pag.

(*Simaethis a-caeruleum* Pag., JB. Nass. Ver. 1884, 287.)

Amboina. Not known to me.

217. *S. metallica* Turn.

(*Simaethis metallica* Turn., Trans. Roy. Soc. S. Austr. 1898, 202.)

Townsville and Brisbane, Queensland. Bred in December by Mr. Dodd.

218. *S. plumbealis* Pag.

(*Simæthis plumbealis* Pag., JB. Nass. Ver. 1884, 288.)

Amboina. Not known to me.

219. *S. chalcotoxa* Meyr.

(*Simæthis chalcotoxa* Meyr., Trans. Ent. Soc. Lond. 1886, 287.)

Tonga and Fiji Islands.

220. *S. orthogona* Meyr.

Simæthis orthogona Meyr., Trans. Ent. Soc. Lond. 1886, 287.)

New Guinea. Also from Ceylon.

221. *S. melanopepla* Meyr.

(*Simæthis melanopepla* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 212.)

Sydney, New South Wales, in November.

37. GLYPHIPTERYX Hb.

I do not consider it advantageous to maintain *Phryganostola* and *Apistomorpha* as distinct genera, as increased material shows that they would not be natural groups, whilst when merged in *Glyphipteryx*, the whole forms a very easily recognised and well-marked genus. As the Australian species now number 43, I give a tabulation to assist identification.

1.	Cilia of forewings with dark line indented below apex	2.
	Cilia of forewings with dark line not indented	36.
2.	Forewings with pale dorsal spot near base	3.
	Forewings without dorsal spot near base	18.
3.	Forewings with more or less black posterior marking	4.
	Forewings without black posterior marking	12.
4.	Forewings with black tornal patch and more or less striation above it	5.
	Forewings without such markings	11.
5.	Forewings with whitish spot on base of dorsum	249. *cyanophracta.*
	Forewings without basal spot	6.
6.	Subbasal dorsal spot connected with costa	7.
	Subbasal dorsal spot not connected with costa	9.
7.	First two entire transverse streaks parallel	8.
	First two entire transverse streaks converging towards costa	245. *asteriella.*
8.	Second transverse streak whitish on dorsum	247. *pharetropis.*
	Second transverse streak not whitish on dorsum	248. *parazona.*
9.	Subbasal dorsal spot outwardly oblique	252. *phosphora.*
	Subbasal dorsal spot rather inwardly oblique	10.
10.	Second joint of palpi with long projecting scales beneath	251. *argyrosema.*
	Second joint of palpi shortly scaled	250. *iometalla.*
11.	Subbasal dorsal spot outwardly oblique	246. *amblycerella.*
	Subbasal dorsal spot erect	244. *isozela.*
12.	Two anterior dorsal spots yellow	238. *chrysoplanetis.*
	Two anterior dorsal spots whitish	13.
13.	Two anterior dorsal spots erect	14.
	Two anterior dorsal spots outwardly oblique	15.
14.	Forewings with metallic discal dot at $\frac{4}{5}$	236. *platydisema.*
	Forewings without such dot	237. *meteora.*

15. Forewings with six pale streaks from costa......... 16.
Forewings with seven pale streaks from costa..... 17.
16. Dorsal streaks sharply marked........................ 239. *leucocerastes.*
Dorsal streaks indistinct................................ 235. *sabella.*
17. Forewings with several metallic dots in disc posteriorly.. 240. *tetrasema.*
Forewings without such dots.......................... 234. *deuterastis.*
18. Forewings with black posterior markings.......... 19.
Forewings without black posterior markings....... 22.
19. Forewings with short white streak from base along fold.. 254. *brachyaula.*
Forewings without basal streak .... 20.
20. Forewings with black metallic-marked tornal patch.. 21.
Forewings without such patch........................ 255. *calliscopa.*
21. Tornal black patch with three metallic bars....... 256. *cometophora.*
Tornal black patch with five or six metallic dots. 253. *lamprocoma.*
22. Forewings with white median streak from base... 23.
Forewings without such streak....................... 26.
23. Costal streaks distinct and sharply defined........ 24.
Costal streaks indistinct, partly suffused........... 232. *mesaula.*
24. Third costal and tornal streaks united............... 231. *euthybelemna.*
Third costal and tornal streaks not united ...... 25.
25. Forewings with six costal streaks..................... 233. *macrantha.*
Forewings with seven costal streaks................ 230. *macraula.*
26. Forewings with white subdorsal streak from base 27.
Forewings without such streak........................ 28.
27. Forewings with oblique white postmedian streak from dorsum...................................... 223. *protomacra.*
Forewings without such streak....................... 222. *halimophila.*
28. Forewings with entire transverse anterior streak. 29.
Forewings without such streak........................ 30.
29. First costal streak reaching dorsum.................. 242. *holodesma.*
Second costal streak reaching dorsum .... 241. *metronoma.*
30. Forewings with silvery-metallic dorsal spots....... 243. *drosophaes.*
Forewings without such spots......................... 31.
31. Forewings with oblique white mark above dorsum in middle.. 224. *autopetes.*
Forewings without such mark.......................... 32.
32. Forewings with oblique white streak from dorsum beyond middle...................................... 33.
Forewings without such mark......................... 229. *palaeomorpha.*
33. Forewings with five white costal streaks........... 225. *acinacella.*
Forewings with six white costal streaks............ 34.

34. Tornal metallic mark erect..	35.
Tornal metallic mark oblique.....	228. *callicrossa.*
35. Dorsal oblique streak uniting with second costal..	226. *gonoteles.*
Dorsal oblique streak not reaching second costal.	227. *actinobola.*
36. Forewings with black blotch in centre of disc......	257. *gemmipunctella.*
Forewings without central blotch.	37.
37. Forewings with black posterior marking...........	38.
Forewings without black posterior marking........	41.
38. Black posterior mark resting on tornus.....	39.
Black posterior mark not reaching tornus...... ...	261. *cyanochalca.*
39. Forewings with continuous metallic terminal streak to tornus....	263. *polychroa.*
Forewings without continuous terminal streak. ..	40.
40. Antepenultimate costal streak direct.	264. *trigonaspis.*
Antepenultimate costal streak very oblique inwards	262. *anaclastis.*
41. First costal streak extended to dorsum.............	260. *tripselia.*
First costal streak not crossing fold................	42.
42. Forewings with supramedian metallic streak from base........	259. *perimetalla.*
Forewings without such streak......................	258. *chalcostrepta.*

Sect. A. Dark line in cilia of forewings indented beneath apex.

222. *G. halimophila* Low.

(*Glyphipteryx halimophila* Low., Trans. Roy. Soc. S. Austr. 1893, 183.)

Sydney, New South Wales; Adelaide, South Australia; Perth and Albany, West Australia; in September and October. The peculiar white subdorsal streak separates this from all others

223. *G. protomacra*, n.sp.

♂♀. 9-12 mm. Head and thorax dark shining bronze, with a white stripe on side of head becoming subdorsal on thorax. Palpi white with four black rings, apex black in front, scales short. Antennæ grey. Abdomen bronzy-fuscous. Forewings elongate, narrow, costa slightly arched, apex round-pointed, termen hardly sinuate, very oblique; shining bronze; a white very oblique line from dorsum near base to beneath fold before middle; seven diversely oblique white blackish-edged streaks from costa, reaching nearly half across wing, tending to become

violet-golden-metallic in disc, first from $\frac{1}{3}$; an oblique white wedge-shaped mark from dorsum beyond middle, nearly or quite reaching a violet-golden-metallic dot in disc at $\frac{2}{3}$; a nearly erect violet-golden-metallic black-edged streak from dorsum before tornus, and another along lower part of termen; a round blackish apical spot, preceded on termen by a small violet-golden-metallic black-edged mark: cilia bronzy, outer half whitish with an indentation below apex, above apex wholly bronze tipped with blackish. Hindwings and cilia dark grey.

Geraldton and Perth, West Australia, in October and November, thirteen specimens. The long oblique streak from near base of dorsum is unique.

224. *G. autopetes*, n.sp.

♂. 8 mm. Head and thorax dark bronze, with a fine white line on side of head, becoming subdorsal on thorax. Palpi white with four black rings, apex black in front, scales short. Antennæ dark grey, beneath whitish. Abdomen dark grey. Forewings elongate, narrow, costa gently arched, apex round-pointed, termen very obliquely rounded; deep bronze; a slender white streak along dorsum from base to $\frac{2}{3}$; a very oblique white streak from above this beyond middle to fold at $\frac{3}{4}$; six diversely oblique white blackish-edged streaks from costa, first from beyond $\frac{1}{3}$, shorter, second and third reaching half across wing, tips violet-metallic; an erect violet-silvery-metallic blackish-edged streak from tornus, almost reaching second costal, and another along lower part of termen; a round black apical spot, beneath which is a violet-golden-metallic dot on termen: cilia whitish, basal half bronzy limited by a dark fuscous line indented on subapical dot, on costa dark fuscous barred with white, with a dark fuscous apical hook. Hindwings dark grey; cilia grey.

Albany, West Australia, in December; two specimens.

225. *G. acinacella* Meyr.

(*Glyphipteryx acinacella* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 193.)

Warragul, Victoria; Deloraine, Tasmania; in November and December.

226. *G. gonoteles*, n.sp.

♂♀. 6-7 mm. Head and thorax dark bronze. Palpi white with four black rings, apex black in front, scales short. Antennæ dark fuscous. Abdomen bronzy-fuscous, beneath white. Forewings elongate, costa gently arched, apex round-pointed, termen very obliquely rounded; deep bronze; six diversely oblique silvery-white streaks from costa, edged with dark fuscous, first from ⅓, second uniting with a similar streak from dorsum beyond middle to form an acutely angulated fascia, third silvery-tipped. almost or quite connected with a nearly erect silvery-metallic streak from dorsum before tornus; a silvery-metallic mark along lower part of termen, and a dot above its posterior extremity; a round black apical spot, beneath which is a silvery-metallic dot: cilia whitish, basal third bronzy limited by a blackish line indented beneath apex, above apex dark fuscous marked with white. Hindwings and cilia dark fuscous.

Gisborne, Victoria (Lyell); Deloraine, Tasmania; in November and December, seven specimens.

227. *G. actinobola* Meyr.

(*Glyphipteryx actinobola* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 241.)

Sydney, New South Wales, in October and November.

228. *G. callicrossa*, n.sp.

♂♀. 10-15 mm. Head, thorax, and abdomen bronzy-fuscous. Palpi white mixed with dark fuscous, with rough projecting hairs diminishing to apex. Antennæ dark fuscous Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen sinuate, oblique; light bronzy-fuscous, deeper in ♀; an oblique white wedge-shaped mark from dorsum beyond middle; six diversely oblique silvery-metallic black-edged streaks from costa, white on costa and in cilia, first near before middle, rather short, second and third reaching half across wing; a silvery-metallic dot in disc before apex of second; an oblique silvery-metallic black-edged streak from dorsum before tornus, another

along lower part of termen, and a short one from termen above middle; a small oval black apical spot: cilia whitish, with blackish basal line indented beneath apex, on costa bronzy with blackish tips towards apex. Hindwings rather dark grey; cilia grey, becoming pale yellow on lower half of termen and dorsum.

York and Geraldton, West Australia, in October and November; two specimens. The yellow cilia of hindwings are a special character.

229. *G. palaeomorpha* Meyr.

(*Glyphipteryx palaeomorpha* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 242.)

Brisbane, Queensland; Bulli, New South Wales; Mount Macedon and Gisborne, Victoria; Deloraine, Hobart, and George's Bay, Tasmania; Mount Gambier, South Australia; from September to January.

230. *G. macraula*, n.sp.

♂♀. 9-10mm. Head and thorax pale greyish-bronze or whitish-bronze. Palpi white with four black rings, apex black in front, beneath with rather short projecting hairs. Antennæ bronzy-fuscous. Abdomen bronzy-grey. Forewings elongate, rather narrow, costa gently arched, apex pointed, termen very obliquely rounded; bronze, more or less mixed with dark fuscous; a rather broad white median streak from base to beyond middle, marked beneath with a black line on fold towards middle; seven diversely oblique short white dark-edged streaks from costa, first from before $\frac{1}{3}$, second and third longer; sometimes additional whitish streaks before and beyond third; an oblique silvery-metallic blackish-edged streak from before tornus, almost meeting third costal streak, and a spot on lower part of termen; a silvery-metallic dot beneath or touching fourth costal streak; a roundish black apical dot, beneath which is a silvery-metallic dot: cilia whitish, basal third bronzy limited by a blackish line, indented beneath apex, on costa barred with white and blackish, with a blackish supra-apical hook. Hindwings and cilia grey.

Deloraine, Tasmania, in December; eight specimens.

231. *G. euthybelemna* Meyr.

(*Phryganostola euthybelemna* Meyr., Proc.Linn.Soc.N.S.Wales, 1880, 250.)

Bathurst, New South Wales; Melbourne, Victoria; Launceston, Deloraine, and Hobart, Tasmania; Wirrabara and Mount Lofty, South Australia; from October to January.

232. *G. mesaula*, n.sp.

♂. 11 mm. Head and thorax whitish-bronze. Palpi whitish banded with fuscous, beneath with projecting hairs. Antennæ dark fuscous. Abdomen whitish-ochreous. Forewings elongate, narrow, costa gently arched, apex acute, termen subsinuate, very oblique; 7 and 8 stalked; whitish-bronze, with indications of fuscous longitudinal lines; a suffused whitish streak along dorsum; a moderately broad white streak from base above fold almost to tornus, edged posteriorly with dark fuscous; eight ill-defined short oblique white marks from costa, edged anteriorly with dark fuscous, becoming suffused and indistinct in disc, first from $\frac{2}{5}$, third long and sharper-defined, reaching apex of median streak; a string of about five silvery-whitish dots on lower part of termen, edged anteriorly with dark fuscous; a small black apical dot, beneath which is a silvery-metallic dot: cilia whitish, with a dark fuscous median line indented beneath apex, and a dark fuscous supra-apical hook. Hindwings and cilia whitish-grey.

Wirrabara, South Australia, in October; one specimen.

233. *G. macrantha* Low.

(*Phryganostola macrantha* Low., Trans.Roy.Soc.S.Austr.1905, 113.)

Gisborne, Victoria, in October. Not known to me.

234. *G. deuterastis*, n.sp.

♀. 10-12 mm. Head, antennæ, thorax, and abdomen bronzy-fuscous. Palpi white banded with fuscous, beneath with projecting hairs. Forewings elongate, narrow, costa gently arched, apex round-pointed, termen sinuate, oblique; bronze, mixed with

rather dark fuscous; two oblique whitish streaks from dorsum before and beyond middle, reaching fold; seven diversely oblique slender white dark-edged streaks from costa, first from $\frac{1}{3}$; a white dot in disc at $\frac{3}{5}$; an oblique silvery-metallic dark-edged streak from dorsum before tornus, and another along lower part of termen; a silvery-metallic dot on termen above middle; an oval black apical spot: cilia white, basal half bronze limited by a blackish line, indented on the metallic dot, with a dark fuscous hook above apex. Hindwings dark fuscous; cilia fuscous.

Perth (Greenmount), West Australia, in November; three specimens.

235. *G. sabella* Newm.

(*Glyphipteryx sabella* Newm., Trans. Ent. Soc. Lond., N.S. iii., 299; Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 237.)

Mount Alexander Range, Victoria. I am still unable to identify this species.

236 *G. platydisema* Low.

(*Glyphipteryx platydisema* Low., Trans.Roy.Soc.S. Austr.1893, 183.)

Gisborne, Victoria (Lyell); Deloraine, Tasmania; in November. Larva in stems of *Juncus*. The difference in the sexes is unusual, the markings in the female being much broader.

237. *G. meteora* Meyr.

(*Glyphipteryx meteora* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 237.)

Brisbane, Queensland; Murrurundi, Bathurst, and Bulli, New South Wales; Melbourne and Mount Macedon, Victoria; Launceston, Campbelltown, Deloraine, and Hobart, Tasmania; Mount Lofty and Wirrabara, South Australia; from October to December.

238. *G. chrysoplanetis* Meyr.

(*Glyphipteryx chrysoplanetis* Meyr., Proc.Linn.Soc.N.S.Wales, 1880, 238.)

Brisbane, Toowoomba, and Wallangarra, Queensland; Glen Innes, Murrurundi, and Sydney, New South Wales; Melbourne

and Healesville, Victoria; Campbelltown, Deloraine, George's Bay and Hobart, Tasmania; from October to December, and in March.

239. *G. leucocerastes* Meyr.

(*Glyphipteryx leucocerastes* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 239.)

Murrurundi, New South Wales, in November.

240. *G. tetrasema* Meyr.

(*Glyphipteryx tetrasema* Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 191.)

Mount Wellington, Tasmania, in February.

241. *G. metronoma*, n.sp.

♂. 8 mm. Head, antennæ, and thorax dark bronzy-fuscous. Palpi whitish banded with black, second joint with rough projecting scales beneath. Abdomen grey. Forewings elongate, costa gently arched, apex round-pointed, termen subsinuate, very oblique; 7 and 8 stalked; dark bronzy fuscous, base of scales whitish; six violet-silvery-metallic streaks from white dots on costa, first from $\frac{1}{5}$, somewhat oblique, rather short, second from before middle of costa to dorsum beyond middle, third from $\frac{3}{5}$ of costa to dorsum before tornus, interrupted in middle, fourth and fifth short, sixth apical, interrupted by a blackish dot: a silvery-metallic dot in disc beyond third streak; an irregular violet-silvery-metallic mark along lower part of termen : cilia whitish, basal half fuscous limited by a blackish line indented beneath apex, on costa dark fuscous barred with whitish, with a blackish apical hook. Hindwings and cilia grey.

Gisborne, Victoria, in November; one specimen (Lyell).

242. *G. holodesma* Meyr.

(*Glyphipteryx holodesma* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 190.)

Mount Wellington, Tasmania, in December and February.

243. *G. drosophaes* Meyr.

(*Phryganostola drosophaes* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 249.)

Sydney, New South Wales; Deloraine, Tasmania; in October and December.

244. *G. isozela*, n.sp.

♂♀. 11-13 mm. Head and thorax dark bronze, side of head with a fine white line. Palpi white with four black rings, apex black in front, scales short. Antennæ and abdomen dark bronzy-fuscous. Forewings elongate, rather dilated posteriorly, costa gently arched, apex obtuse, termen sinuate, oblique; shining bronze mixed with dark fuscous, especially on margins and towards base; a moderate erect white fascia from dorsum at ¼, narrowed upwards and not reaching costa; six violet-silvery-metallic dark-edged nearly direct streaks from white dots on costa, first at ⅓, terminating in a trapezoidal white spot on dorsum beyond middle, second to fourth reaching nearly half across wing, fifth somewhat curved and continued to tornus, sixth ante-apical, reaching termen; discal area between first and fifth irregularly marked with black, with three violet-silvery-metallic dots on a submedian irregular black streak, and one or two subconfluent towards tornus: cilia whitish, basal half bronzy limited by a blackish line indented beneath apex, above apex dark fuscous marked with white. Hindwings dark grey; cilia grey.

Mount Kosciusko (4500 feet), New South Wales; Deloraine, Tasmania; in December and January, seven specimens.

245. *G. asteriella* Meyr.

(*Glyphipteryx asteriella* Meyr., Proc. Linn. Soc. N.S. Wales, 1880, 235.)

Shoalhaven, New South Wales; Melbourne, Victoria; in January.

246. *G. amblycerella* Meyr.

(*Glyphipteryx amblycerella* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 189.)

Melbourne, Healesville, and Warragul, Victoria, in November and December.

247. *G. pharetropis*, n.sp.

♂. 11 mm. Head and thorax dark bronze. Palpi whitish, mixed and ringed with blackish, with rough projecting hairs beneath. Antennæ and abdomen dark fuscous. Forewings elongate, costa gently arched, apex obtuse, termen subsinuate, oblique; golden-bronze, towards base suffused with dark fuscous; a golden-whitish transverse streak from $\frac{1}{5}$ of costa to $\frac{1}{4}$ of dorsum; six pale violet-golden-metallic streaks from white dots on costa, edged with dark fuscous, first at $\frac{1}{4}$, short, second from $\frac{2}{5}$ of costa to dorsum beyond middle, becoming ochreous-whitish towards dorsum, third parallel, entire, fourth and fifth very short, sixth ante-apical, reaching termen; between third and sixth in upper part of disc a violet-golden-metallic dot and two or three fine black lines, and in lower part an irregular black blotch, marked with one golden-metallic dot above tornus, and three on lower part of termen: cilia whitish, basal half bronzy limited by a blackish line indented beneath apex, above apex dark fuscous marked with white. Hindwings dark grey; cilia grey.

Gisborne, Victoria, in March; two specimens (Lyell).

248. *G. parazona*, n.sp.

♂. 11 mm. Head and thorax dark bronze, face whitish-edged. Palpi whitish, with four black rings, apex black in front, scales short. Antennæ and abdomen dark bronzy-grey. Forewings elongate, costa gently arched, apex obtuse, termen rounded, rather strongly oblique; ochreous-bronze, suffused with dark fuscous on margins and towards base; two direct parallel pale violet-golden-metallic transverse streaks before middle, first whitish on dorsum; a pale violet-golden-metallic dot on costa beyond middle, and a curved streak from a white dot on costa at $\frac{3}{4}$ to tornus; area between this and antemedian streak nearly all occupied by a large black blotch, of which the upper half is crossed by about six whitish-ochreous longitudinal lines, lower half marked with five golden-metallic dots; an almost apical transverse golden-metallic streak, extremity white: cilia white, basal half bronze limited by a blackish line indented beneath

apex, above apex blackish marked with white. Hindwings dark grey; cilia grey.

Gisborne, Victoria, in April; one specimen (Lyell). At first sight very similar to the preceding species from the same locality, but on examination the markings are seen to be quite different in detail; in *pharetropis* the first fascia is much nearer the base, there is an additional costal streak between it and the second fascia, there is an additional fascia beyond second, the penultimate streak is very short instead of being continued to tornus, and the palpi are rough-haired.

249. *G. cyanophracta* Meyr.

(*Glyphipteryx cyanophracta* Meyr., Proc.Linn.Soc.N.S.Wales, 1882, 186.)

Burragorang, New South Wales; Melbourne, Victoria; in April.

250. *G. iometalla* Meyr.

(*Glyphipteryx iometalla* Meyr., Proc.Linn.Soc.N.S.Wales, 1880, 232.)

Brisbane, Queensland; Sydney, New South Wales; from August to November.

251. *G. argyrosema* Meyr.

(*Apistomorpha argyrosema* Meyr., Proc. Linn. Soc. N.S.Wales, 1880, 247.)

Mount Tambourine, Queensland; Sydney and Bowenfels, New South Wales; Campbelltown, Tasmania; from September to March.

252. *G. phosphora*, n.sp.

♂. 10 mm. Head, thorax, and abdomen bronze. Palpi white with four blackish rings, apex black in front, scales short. Antennæ dark grey. Forewings elongate, costa gently arched, apex obtuse, termen subsinuate, rather strongly oblique; dark bronze; an oblique suffused whitish spot from dorsum at $\frac{1}{4}$, reaching fold; six violet-silvery-metallic nearly direct streaks from white dots on costa, first from $\frac{1}{3}$, rather short, somewhat oblique, second from middle of costa to dorsum beyond middle,

whitish on dorsum, third and fourth reaching middle, fifth very short, sixth ante-apical, to termen beneath apex; a pale violet-golden-metallic streak from dorsum before tornus, nearly reaching fourth costal; a longitudinal black mark along lower half of termen, containing three golden-metallic dots, above which are three or four fine black longitudinal lines: cilia whitish, basal half bronzy limited by a dark fuscous line indented beneath apex, above apex dark fuscous (?). Hindwings dark fuscous; cilia fuscous.

Wirrabara, South Australia, in October; one specimen.

253. *G. lamprocoma*, n.sp.

♂♀. 8-9 mm. Head and thorax bronze. Palpi whitish mixed with blackish, with rough projecting hairs beneath. Antennæ and abdomen dark grey. Forewings elongate, costa gently arched, apex round-pointed, termen hardly sinuate, rather strongly oblique; ochreous-bronze; six violet-silvery-metallic nearly direct streaks from white spots on costa, first from ⅓, somewhat oblique, reaching fold, second from before middle of costa to dorsum beyond middle, third to fifth short, sixth ante-apical, to termen beneath apex; a triangular black patch resting on lower half of termen, containing two anterior and three posterior golden-metallic spots, and two or three undefined bronzy marks between them; above this patch several subconfluent longitudinal ochreous-whitish lines: cilia white, basal third bronze limited by a blackish line indented beneath apex, above apex bronzy mixed with blackish. Hindwings grey; cilia light greyish-ochreous.

Adelaide, South Australia, in October; two specimens.

254. *G. brachyaula*, n.sp.

♂. 9 mm. Head and thorax dark bronze. Palpi whitish with four black rings, apex black in front, scales short. Antennæ and abdomen dark fuscous. Forewings elongate, costa slightly arched, apex obtuse, termen sinuate, oblique; deep golden-bronze; a white streak from base along fold to ¼; five pale violet-golden-metallic dark-edged streaks from whitish dots on costa, first from

$\frac{1}{3}$ of costa to dorsum beyond middle, whitish on dorsum, second from middle of costa, not quite reaching a golden-metallic blackish-edged dot in disc, third curved, from $\frac{2}{3}$ of costa to dorsum before tornus, fourth from $\frac{5}{6}$ of costa to termen above tornus, fifth ante-apical; a golden-metallic dot between second and third above middle; between third and fourth some undefined slender longitudinal blackish lines, and a stronger irregular black streak below middle: cilia whitish, basal half bronze limited by a dark fuscous streak indented beneath apex, above apex dark fuscous. Hindwings and cilia dark fuscous.

Queensland (?); one specimen, without note of locality.

255. *G. calliscopa* Low.

(*Glyphipteryx calliscopa* Low., Trans. Roy. Soc. S. Austr. 1905, 112.)

Melbourne, Victoria, in November. Not known to me.

256. *G. cometophora* Meyr.

(*Glyphipteryx cometophora* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 231.)

Blackheath, New South Wales; Melbourne and Trafalgar, Victoria; George's Bay, Tasmania; from November to January.

257. *G. gemmipunctella* Walk.

(*Glyphipteryx gemmipunctella* Walk., Char. Het. 86; *G. atristriella* Zell., Hor. Ross. 1877, 398; Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 230; *G. chrysolithella* Meyr., Proc. Linn. Soc. N. S. Wales, 1880, 229.)

Brisbane, Queensland; Sydney and Blackheath, New South Wales; Melbourne, Healesville, Sale, and Traralgon, Victoria; George's Bay, Tasmania; from February to April. Varies locally in the development of yellow in the hindwings.

Sect. B. Dark line in cilia of forewings not indented beneath apex.

258. *G. chalcostrepta*, n.sp.

♂♀. 14-15 mm. Head and thorax bronze; in ♂ a lateral pencil of scales from behind prosternum. Palpi white ringed with

blackish, second joint with projecting scales beneath. Antennæ whitish ringed with dark fuscous. Abdomen bronzy-grey, segmental margins whitish. Forewings elongate, narrow, costa gently arched, apex round-pointed, termen very obliquely rounded; 7 and 8 stalked; in ♂ beneath with a long black bristle from base of costa; light golden-bronze, anteriorly infuscated; a fine line of black scales along submedian fold from base, terminating in a silvery-metallic mark near posterior extremity; five pale golden-metallic partially black-edged streaks from yellow-whitish spots on costa, first from before middle of costa, rather oblique, not reaching fold, second from beyond middle of costa to dorsum before tornus, slightly curved, interrupted by a small blackish spot below middle, third from $\frac{3}{4}$ of costa to tornus, fourth short, fifth almost terminal from apex to near tornus: cilia ochreous-whitish, basal third bronzy limited by a blackish shade, above apex blackish barred with ochreous-whitish. Hindwings and cilia grey.

Deloraine, Tasmania, in December; two specimens.

259. *G. perimetalla* Low.

(*Glyphipteryx perimetalla* Low., Trans. Roy. Soc. S. Austr. 1905, 112.)

Stawell, Victoria, in November. Not known to me; according to the description it should be near *tripselia*, but with antennæ fuscous, and first transverse streak not crossing fold.

260. *G. tripselia*, n.sp.

♂. 12 mm. Head and thorax bronze. Palpi white with four black rings, apex black in front, beneath with projecting scales. Antennæ white ringed with black. Abdomen bronzy-grey, segmental margins whitish. Forewings elongate, rather narrow, costa gently arched, apex round-pointed, termen nearly straight, rather strongly oblique; golden-bronze; markings pale violet-golden-metallic, on costa white, edged with a few scattered black scales; a streak above middle from base to $\frac{1}{3}$, enlarged posteriorly, and another subdorsal from base to $\frac{2}{5}$; three parallel entire trans-

verse streaks, first from before middle of costa to dorsum beyond middle, third from before $\frac{3}{4}$ of costa to tornus; a short streak from costa beyond this, and one almost apical to termen below middle: cilia bronze, outer half mixed with whitish, on tornus obscurely barred with whitish and fuscous, on costa barred with white. Hindwings grey; cilia pale grey.

Gisborne, Victoria, in January; one specimen (Lyell).

261. *G. cyanochalca* Meyr.

(*Glyphipteryx cyanochalca* Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 185; *G. lyelliana* Low., Trans. Roy. Soc. S. Austr. 1893, 182.)

Blackheath and Mittagong, New South Wales; Gisborne, Victoria; Mount Lofty, South Australia; in February and March.

262. *G. anaclastis*, n.sp.

♂. 12-16 mm. Head and thorax bronze. Palpi whitish with four blackish rings, beneath with projecting scales. Antennæ dark fuscous. Abdomen bronzy-grey. Forewings elongate, rather narrow, costa gently arched, apex round-pointed, termen very obliquely rounded; light golden-bronze; a curved silvery-metallic streak from base above fold, crossing fold at $\frac{1}{4}$ and continued to near dorsum before middle; five silvery-metallic streaks from costa, first from $\frac{1}{3}$, oblique, reaching fold, extended along costa to near base, second from middle of costa to dorsum beyond middle, interrupted on fold, third from $\frac{3}{4}$ of costa very obliquely inwards to disc beyond middle, fourth near apex, to termen below middle, fifth almost apical; a silvery-metallic dot or mark in disc between third and fourth; an oblique black bar from beneath apex of third to termen above tornus, cut by three golden-metallic spots extended downwards beyond it; a silvery-metallic dot on dorsum before tornus: cilia whitish-fuscous, basal half bronzy, not indented beneath apex, on costa barred with whitish. Hindwings and cilia grey.

Gisborne and Traralgon, Victoria; Mount Lofty, South Australia; in April, three specimens (Kershaw, Lyell, Guest).

263. *G. polychroa* Low.

(*Glyphipteryx polychroa* Low., Proc.Linn.Soc.N.S.Wales,1897, 23.)

♂. 11-14 mm. Head and thorax bronze. Palpi whitish with four dark fuscous rings, without projecting hairs. Antennæ dark fuscous. Abdomen bronzy-fuscous, segmental margins whitish. Forewings elongate, rather narrow, costa slightly arched, apex obtuse, termen obliquely rounded; fuscous-bronze; a pale violet-golden-metallic streak from beyond $\frac{1}{3}$ of costa to middle of dorsum; five short or very short violet-golden-metallic streaks from whitish dots on costa between this and apex, and another from apex along termen to tornus; an oblique black bar from disc beyond middle to tornus, cut by three violet-golden metallic spots extended downwards beyond it, with some scattered black scales beneath it; above this indistinct traces of a patch of longitudinal pale lines separated by some scattered black scales: cilia whitish, basal half bronze limited by a dark fuscous shade not indented beneath apex, on costa bronze barred with whitish. Hindwings dark fuscous; cilia fuscous, round apex whitish with basal third dark fuscous.

Melbourne and Gisborne, Victoria, in December and March; three specimens (Lyell, Lower).

264. *G. trigonaspis*, n.sp.

♂♀. 10-12 mm. Head and thorax bronze. Palpi whitish with four black rings, apex black in front, without projecting hairs. Antennæ bronze ringed with black. Abdomen grey. Forewings elongate, rather narrow, costa gently arched, apex tolerably pointed, termen hardly sinuate, rather strongly oblique; golden-bronze; a curved violet-golden-metallic streak from base above fold, crossing fold at about $\frac{1}{4}$ and continued to near middle of dorsum but not reaching it; five violet-golden-metallic finely dark-edged streaks from costa, violet-white on costa, first from $\frac{1}{3}$, oblique, reaching fold, second from middle of costa to dorsum beyond middle, third at $\frac{2}{3}$, direct, reaching half across wing, fourth and fifth near together before apex, reaching termen; a

triangular black patch resting on lower half of termen, with an anterior transverse golden-metallic mark, and four variable sometimes partly conjoined golden-metallic dots; above this a patch of more or less indicated paler longitudinal lines, sometimes separated by fine black lines: cilia whitish, basal third golden-bronze limited by a dark fuscous shade, not indented beneath apex, above apex dark fuscous marked with white. Hindwings dark grey; cilia grey.

Albany, West Australia, in September and October; nine specimens.

38. Snellenia Wals.

Head smooth; tongue developed. Antennæ nearly 1, clothed above with long rough fringe of dense scales from base to near apex, basal joint elongate, without pecten. Labial palpi extremely long, recurved, second joint very long, somewhat rough-scaled anteriorly, terminal joint shorter than second, somewhat rough-scaled anteriorly, acute. Maxillary palpi very short, filiform. Abdomen margined with projecting scales, in ♂ with expansible anal tuft. Posterior tibiæ smooth-scaled, with expansible whorls of scales at origin of spurs. Forewings with 1*b* furcate, 2 from $\frac{4}{5}$, 3 from angle, 7 and 8 stalked, 7 to apex, 11 from middle. Hindwings under 1, very elongate-ovate, cilia 1; 3 and 4 connate, 5-7 parallel.

This and the next genus, with the South American *Tinaegeria*, constitute a group of singular facies, but are certainly to be regarded only as a peculiar development of the *Plutella* group. I think there must be a real phylogenetic connection with the *Aegeridae*, which probably originated from this group, being structurally distinguished therefrom by the loss of vein 8 of hindwings. I do not, however, see any clear evidence of near relation to the Elachistid genera *Oedematopoda* and its allies, although it is possible.

265. *S. lineata* Walk.

(*Tinaegeria lineata* Walk. Cat. viii., 261; *Eretmocera sesioides* Feld., Reis. Nov. pl. cxl., 22; *Snellenia lineata* Wals., Trans. Ent. Soc. Lond. 1889, 16, pl.vi., 4.)

♂♀. 12-15 mm. Head and thorax blue-black, thorax on sides and posteriorly vermilion-red. Palpi blackish, base red. Antennæ blue-black, fringed with scales to $\frac{3}{4}$, above this with suffused white subapical band. Abdomen black, base reddish, with slender white median and ante-apical rings. Legs blue-black, ringed with white. Forewings elongate, narrow, costa almost straight, arched towards apex, apex obtuse, termen very obliquely rounded; vermilion-red, streaked with black in disc and between veins, along dorsum with a thicker blackish streak: cilia purple-blackish. Hindwings reddish-orange; posterior half dark fuscous, sometimes produced anteriorly along termen; cilia dark fuscous.

Sydney, New South Wales, from December to March; twenty-four specimens. This curious insect is locally common amongst *Kunzea capitata* (though I think this is probably not the food-plant) in certain rocky places in the harbour, but I have never received it from elsewhere. It flies in sunshine; and in repose carries the posterior legs semierect above the back, and the antennæ erect and waving. I can suggest no reason for this display except sexual; no other insect or natural object resembling it occurs in the localities, so far as I could perceive. Walker's locality reference is erroneous (see Wals. l.c).

39. Pseudaegeria Wals.

Head smooth; tongue developed. Antennæ $\frac{4}{5}$, clothed above with long rough fringe of dense scales from base to near apex, basal joint without pecten. Labial palpi long, recurved, second joint densely clothed with appressed scales, terminal joint as long as second, slender, acute. Maxillary palpi rudimentary. Abdomen rather broad, towards apex with projecting lateral scales. Posterior tibiæ smooth-scaled, with expansible whorls of scales on origin of spurs. Forewings with 1*b* furcate, 2 from $\frac{4}{5}$, 3 from angle, 7 and 8 stalked, 7 to apex, 11 from middle. Hindwings 1, elongate-ovate, cilia $\frac{1}{4}$; 3 and 4 stalked, 5 parallel, 6 and 7 connate or stalked.

Based on the following species only. In Lord Walsingham's figure of the neuration of forewings vein 1*b* is erroneously given as simple.

266. *P. squamicornis* Feld.

(*Ochsenheimeria squamicornis* Feld., Reis. Nov. pl. cxxxix, 6; *Pseudaegeria squamicornis* Wals., Trans. Ent. Soc. Lond. 1889, 18, pl. iii.

♂♀. 22-24 mm. Head, palpi, antennæ, and thorax iridescent blackish, thorax partly reddish on sides and posteriorly. Abdomen blackish, with slender white median ring. Forewings elongate, narrow, costa almost straight, posteriorly gently arched, apex obtuse, termen obliquely rounded; orange-red; dorsal half black, upper edge projecting streaks towards base along fold and in disc: cilia coppery-blackish. Hindwings reddish-orange; a broad purple-blackish terminal band, anterior edge suffused and irregular; cilia blackish.

Sydney, New South Wales, in October; two specimens. Felder quotes Fiji as a locality (doubtfully), but this is probably erroneous, as are many of his localities for other species.

40. Metaphrastis, n.g.

Head smooth; ocelli present; tongue developed. Antennæ $\frac{4}{5}$, in ♂ fasciculate-ciliated (2), basal joint without pecten. Labial palpi long, curved, ascending, second joint with appressed scales, terminal joint as long as second, slender, acute. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled, with expansible whorls of scales on origin of spurs. Forewings with vein 1*b* shortly furcate, 2 from angle, 7 to costa, 8 absent, 9 and 10 from near 7, 11 from middle, remote. Hindwings 1, elongate-ovate, cilia $\frac{4}{5}$; 4 absent, 5-7 parallel.

A peculiar form, probably with some relationship to the preceding genus.

267. *M. acrochalca*, n.sp.

♂♀. 11-13 mm. Head shining bronze, collar pale yellow. Palpi yellow, terminal joint blackish anteriorly. Antennæ dark bronzy-fuscous. Thorax dark shining bronze. Abdomen light ochreous-yellowish, becoming bronzy towards base. Forewings elongate, narrow, costa slightly arched, apex obtuse, termen

obliquely rounded; rather dark bronzy-fuscous, mixed with blackish, and strewn with linear whitish scales; a moderate rather cloudy white spot towards tornus, and sometimes one towards costa posteriorly; a narrow shining bronze terminal fascia: cilia shining bronze. Hindwings light ochreous-orange; apical half dark fuscous; margins of basal half sometimes suffused with dark fuscous; cilia dark grey, with blackish basal line.

York and Albany, West Australia, from October to December; three specimens.

41. Orthenches Meyr.

Head smooth; ocelli present; tongue developed. Antennæ $\frac{4}{5}$, in ♂ simple or pubescent, somewhat thickened at base, basal joint with strong pecten. Labial palpi moderate or long, recurved, with appressed scales, somewhat rough beneath throughout, terminal joint as long as second or longer, acute. Maxillary palpi filiform, curved, ascending. Posterior tibiæ with appressed scales above. Forewings with 1*b* furcate, 2 almost from angle, 7 to apex or termen, 11 from before middle, secondary cell defined. Hindwings 1, elongate-ovate or ovate-lanceolate, termen sometimes sinuate, cilia $\frac{3}{4}$-1; 2-7 remote, nearly parallel.

A small New Zealand genus, represented in Australia as yet by one species only.

268. *O. epiphricta*, n sp.

♂♀. 9-11 mm. Head whitish, sometimes slightly fuscous-sprinkled. Palpi white, externally grey except apex of joints. Antennæ white ringed with fuscous. Thorax white sprinkled with fuscous. Abdomen grey-whitish. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen straight, oblique; white, finely sprinkled and strigulated with dark fuscous; five small dark fuscous spots on posterior half of costa; stigmata cloudy, ill-marked, dark fuscous, plical directly beneath and sometimes confluent with first discal: cilia whitish, with thick blackish sometimes interrupted subbasal line, and broad dark fuscous subapical shade. Hindwings pale whitish-grey; cilia grey-whitish.

Quorn, South Australia, in October; nine specimens.

42. Phalangitis, n.g.

Head with appressed scales; tongue developed. Antennæ $\frac{2}{3}$, in ♂ serrulate, pubescent, basal joint with dense anterior flap of scales. Labial palpi rather long, straight or somewhat curved, subascending or porrected, clothed with loose or rough scales, terminal joint as long as second, tolerably pointed. Maxillary palpi moderate, loosely scaled, porrected. Posterior tibiæ smooth-scaled. Forewings with 1*b* furcate, 2 from angle, 7 to costa, 8, 9, 10 from near 7, 11 from before middle. Hindwings 1, elongate-ovate, cilia $\frac{4}{5}$; 2-7 separate, tolerably parallel.

Type *P. veterana.* An endemic genus, allied to *Plutella.* The species vary rather considerably in markings, and are difficult to understand. The antennæ are directly porrected in repose.

1.	Head and thorax grey or fuscous...............................	2.
	Head and thorax white, sometimes irrorated with fuscous..	3.
2.	Subcostal streak white, well-defined.........................	272. *veterana.*
	Subcostal streak whitish, suffused............................	271. *triaria.*
3.	Forewings with distinct white subcostal streak............	270. *tumultuosa.*
	Forewings without apparent white streak..................	269. *crymorrhoa.*

269. *P. crymorrhoa*, n.sp.

♂♀. 10-13 mm. Head and thorax white, sometimes tinged with fuscous. Palpi white, second joint externally light brownish except towards apex. Antennæ white, ringed with fuscous. Abdomen whitish. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen obliquely rounded; white, strewn with golden-fuscous strigulæ sprinkled with dark fuscous; variable markings of same colour, consisting principally of two or three small posterior spots on costa, and three or four irregular larger spots arranged in a median longitudinal series and sometimes partially connected to form an irregular streak, and sometimes a dark suffusion along dorsum, but these vary much in different specimens: cilia whitish, with two dark fuscous shades varying in development. Hindwings and cilia white.

Mount Wellington (2500 feet), Tasmania, amongst *Leptospermum* in December, six specimens; also one from Port Lincoln, South Australia, in November, which is apparently identical.

270. *P. tumultuosa*, n.sp.

♂♀. 11-13 mm. Head and thorax white, usually more or less irrorated with fuscous. Palpi fuscous sprinkled with white. Antennæ fuscous, sometimes ringed with whitish. Abdomen grey-whitish. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen rounded, rather strongly oblique; light fuscous, sprinkled and sometimes indistinctly strigulated with dark fuscous, sometimes suffusedly mixed with white; a broad white more or less suffused streak above middle from base to apex, reaching costa towards base, sometimes strewn with scattered dark fuscous strigulæ, lower edge usually sharply defined anteriorly, sometimes marked with two dark fuscous spots representing discal stigmata; three or four small cloudy dark spots on costa posteriorly: cilia whitish with dark fuscous antemedian shade and usually two or three dark fuscous patches, sometimes wholly dark fuscous except a whitish patch above apex. Hindwings and cilia grey-whitish.

Murrurundi, Sydney, and Bathurst, New South Wales; Gisborne, Victoria; Perth and Albany, West Australia; from August to November, and in February, ten specimens.

271. *P. triaria*, n.sp.

♂. 18-19 mm. Head and thorax fuscous, slightly reddish-tinged. Palpi rather dark fuscous, whitish beneath towards base. Antennæ rather dark fuscous. Abdomen whitish-fuscous. Forewings elongate, narrow, costa moderately arched, apex obtuse, termen very obliquely rounded; bronzy-fuscous, obscurely darker strigulated, on submedian fold suffused with darker and purplish-tinged; a broad suffused whitish streak above middle from base to apical portion of costa, anteriorly sharply defined beneath, reaching costa from near base to near middle, sometimes marked with an irregular dark fuscous spot forming an indentation on lower margin at $\frac{1}{3}$, and an oblique dark fuscous spot in middle, posteriorly narrowed and irrorated with fuscous strigulæ; two inwardly oblique dark fuscous marks on costa at $\frac{2}{3}$ and $\frac{5}{6}$:

cilia fuscous mixed with dark fuscous, above apex with a whitish patch. Hindwings light grey; cilia whitish, with pale grey sub-basal shade.

Albany, West Australia, in September and October. This species is easily distinguished from the others by its larger size.

272. *P. veterana*, n.sp.

♂♀. 11-15 mm. Head, palpi, antennæ, and thorax grey. Abdomen whitish-grey. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen obliquely rounded; dark grey, towards dorsum mixed with grey-whitish and appearing indistinctly striated, on costal half blackish-grey; a broad white variable streak above middle from base to apex, sometimes straight, sometimes thrice sinuate so that the lower edge shows three rounded indentations and the upper edge is thrice more or less strongly connected with costa, sometimes interrupted by an oblique bar of groundcolour on central indentation, posteriorly somewhat sprinkled with dark grey: cilia dark grey with two blackish shades, at apex with a white patch. Hindwings grey-whitish or pale grey; cilia whitish.

Sydney, New South Wales, in September, December, and January; fifteen specimens. Larva with 10 pro-legs, fusiform (attenuated towards extremities), anteriorly with short scattered hairs, head very small; uniform dull pale green: feeds openly on *Monotoca elliptica* (*Epacrideæ*), gnawing leaves, in August. Pupa in a white open-network cocoon.

43. Amphithera Meyr.

Whilst still uncertain, it seems probable that this genus should be included here.

273. *A. heteromorpha* Meyr.

(*Amphithera heteromorpha* Meyr., Proc. Linn. Soc. N. S. Wales, 1892, 597.)

Sydney and Bulli, New South Wales; George's Bay, Tasmania; from October to April.

44. DIATHRYPTICA, n.g.

Head with appressed scales; tongue developed. Antennæ $\frac{3}{4}$, in ♂ simple, basal joint rather long, densely scaled, with anterior tuft. Labial palpi moderately long, curved, ascending, thickened with scales and rough in front throughout, second joint relatively short, terminal longer than second, pointed. Maxillary palpi moderate, filiform, porrected. Thorax crested. Posterior tibiæ with appressed scales. Forewings with 1*b* furcate, 2 from near angle, 7 to termen, 8, 9, 10 rather near 7, 11 from before middle. Hindwings 1, subtriangular, cilia $\frac{3}{4}$; 3 and 4 connate, 5-7 parallel.

Obviously allied to *Plutella*, yet with some suggestions of *Glyphipteryx*.

274. *D. proterva*, n.sp.

♂♀. 11-15 mm. Head and thorax pale brownish-ochreous. Palpi pale ochreous, second and terminal joints each with two fuscous rings edged above with whitish. Antennæ grey ringed with blackish. Abdomen light grey. Forewings elongate, rather narrow, costa gently arched, apex obtuse, termen sinuate, oblique; dark grey, towards base, dorsum and termen lighter and sometimes tinged with ochreous; markings pale grey, edged and sometimes suffused with white, and margined with blackish; a rather broad straight fascia from $\frac{1}{4}$ of costa to $\frac{2}{5}$ of dorsum; three fascia-like spots from costa between this and subterminal fascia, more or less confused and subconfluent in disc, reaching half across wing or rather more, central longest; an irregular subterminal fascia from costa before apex to tornus, usually interrupted in middle, upper half with an abrupt excavation on middle of anterior edge: cilia whitish, with two partial grey lines, dark grey patches at apex and on middle of termen, and clear white patches between these and above apex. Hindwings and cilia grey.

Sydney, Wollongong, and Blackheath, New South Wales, from August to December; sixteen specimens. The species is locally common under sheltered ledges of lichen-covered rock, and the larva probably feeds on lichens. The imago when running over

the rock has a curious habit of agitating the wings, together with the hind-legs, on each side alternately.

45. PARAPHYLLIS, n.g.

Head with appressed scales, sidetufts somewhat spreading; tongue developed. Antennæ $\frac{4}{5}$, in ♂ filiform, simple, basal joint short, with dense anterior flap of scales. Labial palpi moderate, slender, porrected, loosely scaled, terminal joint rather longer than second, somewhat pointed. Maxillary palpi very short, filiform. Posterior tibiæ clothed with long fine hairs. Forewings with 2 from towards angle, 7 and 8 stalked, 7 to costa, 11 from before middle. Hindwings $\frac{2}{3}$, lanceolate, cilia $1\frac{1}{2}$; 2 and 3 long-stalked, cell open between 3 and 5, 4 absent, 5 approximated to 6, 6 and 7 short-stalked.

A genus of very dubious affinity; it may be a degenerate development of the *Plutella* group, and at least seems to fit no better elsewhere.

275. *P. scaeopa*, n.sp.

♂♀. 17-20 mm. Head and thorax pale brownish-ochreous, crown sometimes yellowish-tinged. Palpi whitish-ochreous. Antennæ fuscous. Abdomen ochreous. Forewings elongate, narrow, costa moderately arched, bent about $\frac{2}{3}$, apex pointed, termen extremely obliquely rounded; purplish-fuscous; a slight dorsal projection of whitish-ochreous scales towards base; a small whitish-ochreous apical spot: cilia fuscous, base suffused with whitish-ochreous towards tornus. Hindwings rather dark fuscous; cilia fuscous, becoming whitish-ochreous towards base on lower half of termen.

Bathurst, New South Wales; Adelaide, South Australia; York, West Australia; from August to November; four specimens.

46. COPIDORIS, n.g.

Head loosely haired, sidetufts spreading; tongue developed. Antennæ $\frac{3}{4}$, in ♂ shortly ciliated, basal joint moderate, without pecten. Labial palpi very long, recurved, second joint with large rough projecting tuft of scales beneath, terminal joint as long as

second, slender, acute. Maxillary palpi obsolete. Posterior tibiæ clothed with long hairs above. Forewings with 1*b* furcate, upper fork little marked, 2 from $\frac{3}{5}$, 3 from angle, 7 and 8 very long-stalked, 7 to costa, 9 and 10 from near 8, 11 from middle, secondary cell indicated. Hindwings 1, rounded-trapezoidal, cilia $\frac{1}{3}$; 2 widely remote, 3 and 4 connate, 5 somewhat approximated, 6 and 7 short-stalked.

Apparently related to the European genus *Cerostoma*.

276. *C. dimorpha*, n. sp.

♂♀. 17-20 mm. Head ochreous-white. Palpi white, second joint with a brownish-ochreous median band, posterior edge of terminal joint dark fuscous. Antennæ dark fuscous spotted with white. Thorax pale ochreous, centrally more or less suffused with white. Abdomen whitish. Forewings elongate, costa moderately arched, apex acute, termen faintly sinuate, extremely oblique; yellow-ochreous, along costa, dorsum, and termen, or sometimes wholly suffused with rather dark fuscous irrorated with white; usually a clear white median longitudinal streak from base to apex, but sometimes this is suffusedly mixed with fuscous: cilia fuscous sprinkled with whitish, at apex usually with a slender whitish bar. Hindwings grey-whitish, becoming light grey posteriorly; cilia white, at apex greyish.

Sydney, New South Wales; Melbourne, Victoria; in February and March, amongst scrub, apparently very local but plentiful where it occurs; twenty specimens.

47. Trachycentra Meyr.

Head with loosely appressed scales; tongue rudimentary or absent. Antennæ $\frac{1}{2}$-$\frac{2}{3}$, in ♂ simple, basal joint moderate, without pecten. Labial palpi long, curved, ascending, second joint with large rough spreading tuft of projecting scales towards apex beneath, terminal joint as long as second, with appressed scales, laterally compressed, pointed. Maxillary palpi short, drooping. Anterior tibiæ very short, tarsi dilated with rough projecting scales; posterior tibiæ and tarsi with rough projecting scales

above and beneath. Forewings with tufts of scales on surface; 1*b* furcate, 2 and 3 stalked from angle, 7 to termen, 8 and 9 stalked, 10 approximated, 11 from before middle. Hindwings 1, elongate-ovate, apex pointed, termen sinuate beneath apex, cilia $\frac{2}{3}$; 2-7 separate, tolerably parallel, with dense scale-pectens towards base on 1*a* and beneath cell.

Type *T. calamias*. A peculiar genus, belonging to the neighbourhood of the Indian *Dasyses* and *Automachaeris*; apparently characteristic of the islands of the Australasian region, as I have not yet met with it elsewhere. The species require careful discrimination. Their aspect suggests that the larvæ may probably feed on dead wood. All the species show on the forewings three subdorsal tufts of scales, median tuft more remote from dorsum.

1. Forewings narrow	2.
Forewings moderate	4.
2. Forewings with apex produced, termen concave	3.
Forewings with apex not produced, termen sinuate.	279. *psorodes*.
3. Forewings with brownish-ochreous interneural streaks	278. *chlorogramma*.
Forewings with numerous small faint brownish-ochreous spots	277 *calamias*.
4. Forewings with well-marked dark interneural lines..	280. *aulacitis*.
Forewings without dark interneural lines	5.
5. Forewings with suffused dark fascia from base of costa to tornus	281. *amphiloxa*.
Forewings without such fascia	6.
6. Forewings with elongate blackish-fuscous costal patch	282. *sagmatias*.
Forewings without such patch	283. *glaucias*.

277. *T. calamias* Meyr.

(*Trachycentra calamias* Meyr., Trans.Ent.Soc.Lond.1886,288.) Tonga and Fiji.

278. *T. chlorogramma*, n.sp.

♂. 26-30 mm. Head, palpi, antennæ, thorax, and abdomen whitish-ochreous. Forewings elongate, narrow, costa gently arched, apex acute, produced, termen concave, very oblique;

whitish-ochreous, towards dorsum slightly tinged with rosy-fuscous; brownish-ochreous interneural streaks, sometimes sprinkled with fuscous, those running to costa terminated by dots of blackish irroration; dorsal area sometimes sprinkled with fuscous; three normal subdorsal tufts pale, tipped with blackish points: cilia pale whitish-ochreous, with a few fuscous and blackish points. Hindwings grey; cilia whitish-ochreous, suffused with light grey.

Choiseul, Bougainville, Florida, Guadalcanar, Solomon Is.; five specimens (Meek).

279. *T. psorodes*, n.sp.

♂. 25-29 mm Head, palpi, antennæ, and thorax whitish-ochreous, somewhat speckled with fuscous. Abdomen pale ochreous sprinkled with grey. Forewings elongate, narrow, costa gently arched, apex pointed, termen sinuate, rather strongly oblique; pale brownish-ochreous, with numerous small undefined brownish or dark fuscous dots tolerably regularly arranged, posteriorly in interneural series; three normal subdorsal tufts tipped with brownish or blackish: cilia pale brownish-ochreous, with rows of fuscous points. Hindwings grey; cilia pale ochreous, sprinkled with grey.

Choiseul, Isabel, Solomon Is.; two specimens (Meek).

280. *T. aulacitis*, n.sp.

♀. 24-33 mm. Head, palpi, and thorax pale ochreous mixed with brown. Antennæ pale ochreous spotted with fuscous towards base. Abdomen greyish-ochreous. Forewings elongate, costa moderately arched, apex pointed, termen sinuate, oblique; whitish-ochreous; strong brown interneural lines irrorated with blackish, that between 6 and 7 nearly obsolete; a thick suffused brown streak running from base above submedian fold to tornus, upper edge with a projection beyond middle, whence an undefined fascia seems to proceed to costa beyond middle, formed by thickening of interneural lines; some brown suffusion along dorsum: cilia whitish-ochreous, more or less distinctly barred with fuscous

mixed with blackish, more broadly above tornus. Hindwings grey; cilia pale greyish-ochreous, with grey subbasal shade.

Choiseul, New Georgia, Kulambangra, Solomon Is.; five specimens (Meek).

281. *T. amphiloxa*, n.sp.

♂. 22-29 mm. Head and thorax pale ochreous, shoulders sometimes with some brown scales. Palpi whitish-ochreous sprinkled with dark fuscous. Antennæ whitish-ochreous spotted with fuscous. Abdomen pale ochreous, sprinkled with grey. Forewings elongate, costa moderately arched, apex pointed, termen concave, oblique; whitish-ochreous more or less mixed with yellow-ochreous and brown between veins; undefined markings formed by black and brown irroration, viz., a suffused fascia from basal fourth of costa to tornus; small costal spots before and beyond middle, and a submarginal streak from apex to dorsum before tornus; first and third scaletufts mixed with black, second pale: cilia whitish-ochreous mixed with ochreous, at apex and towards tornus mixed with dark brown. Hindwings fuscous, towards base more or less suffused with whitish-ochreous; cilia fuscous, towards dorsum becoming pale greyish-ochreous.

♀. Similar, but forewings almost wholly suffused with dark fuscous except a short pale longitudinal mark in middle of disc.

Bougainville, Choiseul, Rendova, Treasury, Solomon Is.; Sariba I., New Guinea; sixteen specimens (Meek).

282. *T. sagmatias*, n.sp.

♂. 18 mm. Head, palpi, and thorax whitish-ochreous, with a few dark fuscous specks. Antennæ whitish-ochreous, spotted with dark fuscous. Abdomen grey. Forewings elongate, costa moderately arched, apex acute, somewhat produced, termen sinuate, oblique; pale yellowish-ochreous, with some brown irroration towards costa beyond middle, middle of submedian fold, and tornus; a narrow blackish-fuscous patch extending along costa from base to $\frac{3}{4}$, widest and angularly prominent beneath before middle, where it reaches half across wing, posteriorly

attenuated; three blackish dots on costa posteriorly, and one on middle of termen; three normal subdorsal tufts tipped with blackish: cilia pale ochreous, sprinkled with brown, with a small blackish spot opposite middle of termen Hindwings and cilia dark grey.

Sariba Island, New Guinea; one specimen (Meek).

283. *T. glaucias*, n.sp.

♂. 21-25 mm. Head and thorax brownish-ochreous sprinkled with dark fuscous. Palpi pale ochreous, sprinkled with dark fuscous. Antennæ brownish-ochreous, suffusedly ringed with blackish. Abdomen dark grey. Forewings elongate, costa moderately arched, apex pointed, termen sinuate, oblique; pale ochreous, irregularly mixed with ochreous-brown scales with blackish tips; costa irregularly spotted with blackish; round blackish spots in disc before and beyond middle; some undefined blackish suffusion towards termen and tornus: cilia pale ochreous, mixed with brown scales tipped with dark fuscous. Hindwings dark grey, lighter towards base, pecten pale greyish-ochreous; cilia pale greyish sprinkled with dark grey

♀. Similar but mostly suffused with dark fuscous.

Sudest Island, New Guinea; eight specimens (Meek).

48. Plutella Schrk.

Both the following species have probably been artificially introduced, though now widely established.

284. *P. maculipennis* Curt.

(*Plutella maculipennis* Curt. Guide 186; *P. cruciferarum* Zell., Stett. Ent. Zeit. 1843, 281; Meyr., Trans. N.Zeal. Inst. 1885, 177.)

Duaringa and Rosewood, Queensland; Glen Innes (4500 feet), Sydney, Blackheath, Bathurst, Cooma, and Bulli, New South Wales; Melbourne, Warragul, and Mount Macedon, Victoria; Hobart and Deloraine, Tasmania; Mount Gambier, Adelaide, Wirrabara, Quorn, and Port Lincoln, South Australia; Carnarvon,

Geraldton, Perth, York, and Albany, West Australia; in June, and from August to March, common everywhere and often abundant. Occurs also throughout New Zealand and the rest of the globe, probably wherever man has introduced cabbages and turnips, on the leaves of which the larva feeds principally, though it will also eat other *Cruciferæ*. Probably Europe is its original home.

285. *P. sera* Meyr.

(*Plutella sera* Meyr., Trans. N. Zeal. Inst. 1885, 178.)

Rosewood and Brisbane, Queensland; Sydney, New South Wales; Melbourne, Victoria; Geraldton, West Australia; from July to March, not uncommon. Also occurs freely in the North Island of New Zealand and in Ceylon. I am not acquainted with the larva, but it seems likely that, like the preceding, it is attached to some garden plant, and the insect is artificially introduced.

INDEX OF GENERA.

INDEX OF SPECIES.

The numbers refer to those prefixed to each species in succession; names italicised are quoted as synonyms or without being adopted; those without authors' names suffixed are new.

ADDENDUM.

49(37*a*). Burlacena Walk.

Head smooth; ocelli present; tongue developed. Antennæ $\frac{4}{5}$, thick, in ♂ shortly bipectinated, teeth fasciculate-ciliated. Labial palpi rather long, ascending, with appressed scales, terminal joint short, obtuse. Maxillary palpi obsolete. Posterior tibiæ smooth-scaled. Forewings with cell very long, 2 and 3 stalked, 7 and 8 stalked, 7 to apex, 11 from beyond middle. Hindwings 1, elongate-ovate, cilia $\frac{1}{8}$; 4 absent, 6 and 7 stalked.

A transparent-winged form, resembling the *Aegeriadae*, probably allied to *Snellenia*. A second species occurs in Celebes.

286 (264*a*). *B. aegerioides* Walk.

(*Burlacena aegerioides* Walk. Suppl. 80; *B. similata*, ib. 81.)

New Guinea, Mysol.

287. *Yponomeuta paurodes*, n.sp.

♂. 19-23 mm. Head and antennæ white. Palpi white, apex of second joint and a median band of terminal joint black. Thorax white, with two black dots on shoulders, two on back, and one on posterior extremity. Abdomen dark grey, segmental margins and anal tuft white. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen nearly straight, oblique; snow-white; four or five small black dots on anterior half of costa, three beneath posterior half of costa, one at base in middle, five in a submedian series, the third somewhat above the others and rarely with an additional dot above it, three in a subdorsal series, and two on lower part of termen: cilia white. Hindwings dark grey, lighter anteriorly and becoming whitish towards base; cilia white, basal third grey.

Townsville, Queensland; five specimens (Dodd). Near *myriosemus*, but smaller and shorter-winged, forewings with fewer dots generally, and especially no dots on upper half of termen, and only three in subdorsal series.

DECAPOD CRUSTACEA FROM NORFOLK ISLAND.

By the late F. E. Grant, F.L.S., and Allan R. McCulloch,
Australian Museum.

(Plate i.)

The small collection enumerated herein has reached us from two sources. The first series was collected by Messrs. R. M. and W. Laing, the latter a resident of the island, who placed them in the hands of Prof. Chas. Chilton, of Christchurch, N.Z., and who in turn very kindly forwarded them to us. For the others we are indebted to Mr. A. Liddell, for whom they were collected by Mr. J. Cornish Quintal. Our best thanks are due to both our friends.

BRACHYURA.

Tribe CYCLOMETOPA.

Xanthias atromanus (Haswell).

1882. *Xanthodes atromanus* Haswell, Proc. Linn. Soc. N. S. Wales, vi. p.542; and Cat. Aust. Crust. p.49, pl.i. fig 1.

Common (Liddell).

Eriphia norfolcensis, n.sp. (Plate i., figs. 1, 1*a*, 1*b*).

Carapace almost ⅔ as long as broad, gastric and cardiac regions faintly delimited. A well marked groove runs from each lateral angle inwards and forwards in the direction of the orbits. Dorsal surface smooth except on the hepatic regions, which carry a number of subspiniform tubercles, and immediately behind the front where it is granular.

Front emarginate, lobes much deflexed, but their free edge, which is well defined and granular, is visible from above.

The inner orbital angles are separated from the front proper by a shallow sulcus.

Orbits entire, their upper borders granular, the lower minutely spinulose.

Anterior lateral margins short, not lobulate, but carrying five or six small almost equidistant spinulous tubercles.

Chelipeds very unequal, either the right or left the larger. Carpus of larger cheliped smooth proximally, but carrying on its distal margin two rows of rounded tubercles which become spinulous above; some stiff hairs on its anterior margins. The upper margin of the hand is equal to the length of the finger, its inner surface punctate, and the outer with a number of smooth rounded tubercles having a roughly linear arrangement; a patch of short stiff yellow hairs at the base of the wide gape between the fingers. Finger and thumb acuminate, quite smooth; not dentiform, but each showing a tendency to bear a low rounded tubercle.

In the smaller cheliped the tubercles on the outer surface of the palm are markedly spinulous, and the fingers, which are considerably bent inwards, are costate, dentiform, meeting along their whole length when closed, and spoon-excavate at the tips.

Ambulatory legs somewhat flattened and clothed with scattered stiff yellow bristles.

The abdomen of the male is seven-jointed, the third joint being the widest.

Colour in spirits dark chestnut-brown, the chelipeds reddish, fingers black, white at the extreme tips. There is a patch of reddish colour on the palm behind the base of the mobile finger and at the junction of the carpus and propodus.

Dimensions of type (♂):—

Breadth of carapace between lateral angles........	18 mm.
Length of carapace..	13 ,,
Length of larger cheliped.........	30 ,,

A number of specimens were collected by Mr. Liddell, who informs us that it is common on the island, where it is known as the "Poison Crab."

The type is in the Australian Museum.

CYMO ANDREOSSYI (Audouin).

1852. Dana, U. S. Explor. Exped., Crust. i. p.225, pl.xiii. figs.2*a*-*b*.

Common (Liddell).

OZIUS TRUNCATUS M.Edw.

1837. H. Milne Edwards, Hist. Nat. Crust. i. p.406, pl.xvi. fig.11.

Common (Liddell, Laing).

PLAGUSIA DENTIPES De Haan.

1835. De Haan, Faun. Japon., Crust. p.58, pl.viii. fig.1.
1878. Miers, Ann. & Mag. Nat. Hist. (5) i. p.152.

This species differs from *P. capensis* De Haan (= *P. chabrus* Aud.) so common on the Australian coast in the following particulars:—

The lower distal end of the merus of the legs is armed with a spine and not rounded. There is a group of granules on the hepatic regions. There are three or four dentiform processes on the front, the hindermost being the largest, while in *P. capensis* each lobe presents a row of six to seven granules. The teeth on the ambulatory legs are stronger, the hairs on the dorsum of the carapace are shorter and do not in the adult cover the branchial prominences.

In *P. dentipes* rudimentary exopods are also developed on the ambulatory legs.

Common (Liddell, Laing). The species is also common on Lord Howe Island.

PERCNON PLANISSIMUM (Herbst.).

1900. *Leiolophus planissimus* Alcock, Journ. Asiatic Soc. Bengal, lxix. p.439.
1906. Rathbun, U. S. Fish Commission, Bulletin, 1903, p.842.

Common (Liddell).

HYMENOSOMA LACUSTRIS Chilton.

1882. *Elamena* (?) *lacustris* Chilton, Trans. N. Z. Inst. xiv. p.172, pl.viii.
1902. Fulton & Grant, Proc. Roy. Soc. Vict. xv.(N.S.) p.59, pl.viii.

Common (Laing). A freshwater species inhabiting rocky pools. It has also been recorded from New Zealand and Victoria.

Tribe CATOMETOPA.

OCYPODE URVILLEI Guérin.*

1836. Guérin, Voy. "Coquille," Crust. p.9, pl.i. fig.1.
1897. Ortmann, Zool. Jahrb. Syst. x. pp.360 and 366.

Common (Liddell, Laing).

LEPTOGRAPSUS VARIEGATUS (Fabr.).

1853. Milne Edwards, Ann. Sci Nat. (3) xx. p.171.

Common (Liddell, Laing).

PACHYGRAPSUS TRANSVERSUS Gibbes.

1850. Gibbes, Proc. Amer. Assoc. Adv. Sci. iii. p.182.
1900. Rathbun, American Naturalist, xxxiv. p.588, figs.8, 9.

Common (Liddell, Laing).

CYCLOGRAPSUS PUNCTATUS M.Edw.

1837. Milne Edwards, Hist. Nat. Crust. ii. p.78.
1880. Kingsley, Proc. Acad. Nat. Sci. Philad. p.201 (ubi syn.).

Common (Liddell).

PLAGUSIA DEPRESSA var. SQUAMOSA (Herbst.).

1900. Alcock, Journ. Asiatic Soc. Bengal, lxix. p.437.

Common (Liddell).

MACRURA.

Tribe ANOMALA.

CALCINUS IMPERIALIS Whitelegge.

1901. Whitelegge, Records Aust. Mus. iv. p.48, pl.ix.

Common (Liddell, Laing). Also occurs in great numbers on Lord Howe Island.

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* Mr. Grant was inclined to consider this species as a variety of *O. ceratophthalma* Pallas, to which it is closely allied, but as our specimens present all the characters assigned to it by Ortmann, who monographed the genus, they are perhaps best kept distinct until intermediate stages have been obtained.--A.R.M.

CALCINUS LATENS Randall.

1839. Randall, Journ. Acad. Nat. Sci. Philad. p.135(*fide* Dana).
1906. Grant & McCulloch, Proc. Linn. Soc. N. S. Wales, xxxi. p.34.

One specimen (Laing).

CALCINUS HERBSTII De Man.

1887. De Man, Archiv für Naturgesch. liii., i., p.437.
1905. Alcock, Cat. Indian Decapod Crust. ii. p.53.

One specimen (Laing).

PACHYCHELES LIFUENSIS Borradaile. (Plate i. figs.2, 2*a*).

1900. Borradaile, Willey's Zool. Results, p.424.

We refer our specimens to the above species, somewhat briefly diagnosed by its author.

Its nearest ally appears to be *P. barbatus* (A.M.Edw.),* but it differs from the figure of that species given in the "Challenger" Reports in (1) the much narrower front, which is slightly produced medianly; (2) the shape of the orbits, whose external angle is produced as a spine; and (3) the structure of the external maxillipeds, which have the antero-external angle of the ischium produced as a long spine, and the merus slenderer, with its internal lobe cristate.

From *P. sculptus* (M.Edw.),† to which it bears a superficial resemblance, it may be separated by the broader proportions of the carapace, by the shape of the external orbital angles, and by the sculpture of the chelipeds, which in *P. sculptus* have larger granules arranged in more definite rows and not clothed with hairs, while in the specimens under consideration they carry a plentiful pubescence.

Two specimens (Liddell).

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* 1888. Henderson, Challenger "Anomura," p.114, pl.xi. fig.4.

† 1906. Grant & McCulloch, Proc. Linn. Soc. N. S. Wales, xxxi. p.40, pl.ii. fig.1.

Tribe CARIDEA.

ALPHEUS EDWARDSII Audouin.

1809. Audouin, Savigny's Descript. de l'Egypt, pl.x. fig.1.

Common (Liddell, Laing).

XIPHOCARIS COMPRESSA (De Haan).

1849. *Ephyra compressa* De Haan, Faun. Japon., Crust. p.186, pl.xlvi. fig.7.

1894. *Xiphocaris compressa* Ortmann, Proc. Acad. Nat. Sci. Philad. p.400.

A freshwater species. We have a good series taken on both sides of the island by the Messrs. Laing.

The variability of the dentition of the rostrum of specimens from Norfolk Island has already been drawn attention to by G. M. Thomson,* who also records its occurrence in New South Wales and Victoria. We are indebted to Prof. Chilton for pointing out that those taken from streams on the east side of the divide are smaller in size and with a proportionately shorter rostrum than those on the west.

EXPLANATION OF PLATE.

Plate i.

Fig. 1. —*Eriphia norfolcensis*, sp.nov.
Fig. 1*a*.—*Eriphia norfolcensis*, oral region.
Fig. 1*b*.—*Eriphia norfolcensis*, larger cheliped.
Fig. 2. —*Pachycheles lifuensis* Borradaile.
Fig. 2*a*.—*Pachycheles lifuensis*, external maxilliped.

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* 1903. Trans. Linn. Soc. London, Vol. viii. p.449

WEDNESDAY, APRIL 24TH, 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, April 24th, 1907.

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

Messrs. WILLIAM NOEL BENSON, Killara; WALTER L. HAMMOND, B.Sc., Marrickville; ALLAN R. MCCULLOCH, Australian Museum, Sydney; and REGINALD H. RELTON, Mary Street, Brisbane, were elected Ordinary Members of the Society.

The President announced that the Society had been honoured with invitations from the Royal University of Upsala, and the Royal Swedish Academy at Stockholm, to be represented officially at the ceremonial gatherings arranged by them to take place next month in connection with the celebration of the Bicentenary of Carl von Linné, the great Swedish naturalist; and that the Council had deputed Professor J. P. Hill, D.Sc., of University College, London, to act as the Society's envoy.

The President also gave notice of a Special General Meeting of the Society, to be held in the Linnean Hall on Thursday, 23rd May, to mark the occasion of the two-hundredth anniversary of the birth of Linnæus (1707-1778). The Council had approved of a programme which would take the form of a series of short addresses by Members of the Society, especially intended to set forth the place of Linnæus among the pioneers of systematised biological science, and the importance of his work and influence. As the accommodation available would be limited, the Council regretted that it would be unfortunately necessary to restrict the admission of visitors on this occasion. But if desired, and as far as circumstances permitted, one visitor's ticket would be sent to

every Member on application to the Secretary, the tickets to be allotted in the order in which applications were received, so long as accommodation was available.

The President further stated that the Ordinary Monthly Meeting would be held on Wednesday, 29th May. It was requested that Members would postpone Notes and Exhibits to the following Meeting, on 26th June, so that as much time as possible might be available for a discussion of the papers by Messrs. E. C. Andrews, G. H. Halligan, T. G. Taylor and Dr. Woolnough, which appeared in Part 4 of the Proceedings for 1906, recently issued. As it was proposed to make the discussion the feature of the Meeting, Members who wished to take part were requested to take note of the date.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 40 Vols., 56 Parts or Nos., 12 Bulletins, 7 Reports, 30 Pamphlets, and 15 Maps, received from 46 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Froggatt exhibited a very complete and fine collection of sexed examples of Hymenopterous insects of the Family *Thynnidæ*, in illustration of the paper by Mr. Rowland E. Turner. As in the case of the allied family *Mutillidæ*, the male insects are handsome, winged, wasp-like creatures; while the females are small and wingless, and often so unlike the corresponding males that it is usually very difficult to obtain correctly matched pairs.

Mr. Froggatt also showed adult specimens and living, newly hatched young ones, of a grasshopper (*Œdaleus senegalensis* Krauss), which might be regarded as the common plague locust of the eastern coastal area of the State.

Mr. Jensen exhibited a specimen of the Kava-root, *Piper methysticum*, from which the national beverage of the South Sea Islands is made.

Mr. H. Leighton Kesteven exhibited a specimen of the curious fungus, *Aseröe rubra* Labill., collected by Dr. Leighton Kesteven at Mullumbimby, Brunswick River, N.S.W.

Mr. E. Cheel exhibited, and contributed Notes upon, a very interesting collection of Fungi, representing 29 genera and 38 species, including one species and one form not previously described; and several species not hitherto recorded from New South Wales. Series of examples of *Aseröe rubra* Labill., and *Lysurus australiensis* Cke. & Massee, preserved in spirit, and illustrating different stages of growth, were particularly worthy of note. (For a list of the species, see p.202).

Dr. E. S. Stokes showed a remarkable felted deposit of filamentous Algæ from filter-beds at West Maitland; a sample of a diatomaceous deposit (*Amphora* sp.) from the same locality; and a quantity of the dried thalli of *Chroococcus* from the storage reservoir at the same place.

Mr. Duncan Carson sent for exhibition the greater portion of the right ramus of the lower jaw of an immature example of one of the large extinct Marsupials (*Diprotodon australis* Owen) which had been found in what well-sinkers term "wash," at a depth of 40 feet in sinking a well, situated about three miles from Tanbar Springs in the Gunnedah district. The specimen was nine inches in length, a portion of each end of the ramus being missing; and showed the remnants of three cheek-teeth.

Mr. Fletcher showed five typical examples of a frog, *Hyla Ewingii* D. & B., collected recently on King Island, Bass Straits, by Mr. Arthur M. Lea of Hobart. This may perhaps be the frog recorded as "*Hyla* sp." in the "Fauna of King Island," compiled from the collections obtained by Members of the Field Naturalists' Club of Victoria in 1887 (Victorian Naturalist, iv. 139); otherwise the species is unrecorded from this insular habitat.

SOME NEW OR LESS KNOWN DESMIDS FOUND IN NEW SOUTH WALES.

By G. I. Playfair.

(Communicated by the Secretary.)

(Plates ii.-v.)

Only two contributions to a knowledge of the *Desmidiæ* of New South Wales are known to me. Dr. Otto Nordstedt in his "Freshwater Algæ of New Zealand and Australia" gives a list of nine species collected on the Blue Mountains by Dr. S. Berggren. And Dr. M. Raciborski in "Desmidya zebrane przez Dr. E. Ciastonia" accounts for seventy-seven species gathered by Dr. Ciastonia in the Centennial Park, Sydney, in 1891.

During the past fourteen years in which I have studied the Desmids of New South Wales, I have been able to search only three districts, viz., Collector at the northern end of Lake George; Moura, a private estate near Parkes; and some of the suburbs of Sydney My experience harmonises with a remark of Mr. W. B. Turner in his "Freshwater Algæ of E. India" that "From results obtained by many observers it appears that the value of gatherings is often in inverse ratio to the extent of country examined."

The number of species from New South Wales figured to date stands at about 350, a very fair total when it is remembered that only 412 forms are mentioned by Dr. Cooke in his 'British Desmids.' Of these 350, 50 are doubtful or require further investigation, 230 have been definitely identified, and the remaining 70 form the subject of this paper. After most careful consideration, fifty of these are described as new, and also twenty varieties and forms of species previously described by other observers. About one-third of these stand to the credit of

Botany, a third were obtained from Collector, and all other localities together account for the remainder.

It should be mentioned that numerous books and papers have been consulted before committing these notes to paper, but as the publications amount to nearly ninety, it would take up too much space to record my indebtedness to individual authors.

Genus Docidium Bréb.

Doc. expansum, n.sp. (T.iii. f.3).

Doc. minimum, curtum, crassum, 2½ plo. longius quam latum, tumore basali lato, depresso, semicellulis ad apices expansis, apicibus rotundato-truncatis, angulis superioribus lato-rotundatis dentibus nullis, membrana levissime punctata.

Long. 72; lat. 29μ.

Botany.

For a Docidium this form is quite unique.

Genus Pleurotaenium Näg.

Pl. mediolaeve, n.sp. (T.ii. f.10).

Pl. magnum, valde elongatum, rectum, 12-20 plo. longius quam latum; basi semicellulae leviter inflatae et supra, inflatione minore nonnunquam instructae; apices versus sensim sed distincte attenuatae; apicibus truncatis, rugis l. denticulis 10-12 (rarius 4-6) intra marginem semper ornatis; sutura non prosiliente; membrana crassa; usque ad medium inflationum basalium dense scrobiculata (non granulata); scrobiculae trans quemque inflationem in serie densiore ordinatae; membrana in medio frondis laevi (unde nomen).

Long. 410, 504, 516, 528, 660, 684; lat. 36, 30, 38, 33, 37, 31μ.

Auburn.

Pl. mediolaeve belongs to the group having straight sides, and apices furnished only with rugæ, not with pronounced tubercles, such as the forms of *Pl. Ehrenbergii* De Bary, *Pl. crenulatum* (Ehr.), see Roy and Bisset, Jap. Desm. f.19, which come nearest in size and appearance. Others are *Pl. Stuhlmanni* (Hieron.)

Schm.;* *Pl. (Doc.) Wallichianum* Turn.;† *Pl. (Doc.) gloriosum* Turn.‡

Forma GRACILIOR, n.f.

Exacte ut in forma typica sed gracilior, cellulae 20-30 plo. longiores quam latae.

Long. 408, 444, 532; lat. 18, 21, 18μ.

Auburn, Botany.

PL. NODOSUM Bail., γ DENTATUM Arch., Q.J. Micr. Sci. 1872, p.194, forma AUSTRALICA, n.f.

Forma apice modice elongato, vix dilatato, dentibus 10 magnis (fere aculeis) projicientibus. Semicellulae verticillis 4, in quoque verticillo nodulis 6 prominentibus obtusis, fere truncatis, membrana inter verticillos grosse punctata.

Long. 324; lat. 56μ.

Botany.

PL. BACULOIDES (Roy & Bisset), Jap. Desm. p.9, f.18.

Apices denticulis l. rugis minutissimis 8-10 vix visibilibus semper praeditae. Endochroma in taenias longitudinales 4 disposita. Membrana subtilissime punctata. Cetera ut in Jap. Desm.

Long. 390, 400, 426, 428, 438; lat. 14, 15, 14, 15, 15μ.

Auburn, Botany; Rose's Lagoon, Collector.

Roy & Bisset (l.c.) give long. semicell 265μ, lat. 15μ, but the figures tally exactly. The minute teeth were observed in every case, but they are easily overlooked.

Genus TRIPLOCERAS Bailey.

TRIP. SERRATUM, n.sp. (T.ii. f.2).

Trip. magnum, rectum, elongatum, 9-12 plo. longius quam latum, (cum dentibus), basi ad apices sensim attenuatum, apicibus aut 2 lobatis spinis geminatis intervenientibus, aut 4 lobatis lobis

* Ost. Afrik. T.1, f.21-22.

† Alg. E. Ind. T.3, f.2.

‡ l.c. T.3, f.5.

interdum productis bi-(rarius tri-)dentatis. In quaque semicellula verticilli 13-16, dentibus magnis, validis, patentibus 10 instructi; dentibus verticilli basalis in margine inferiore denticulis singulis ornatis.

Long. c. proc. 450, 480, 588; lat. c. dent. 50, 57, 50μ.

Botany.

This form lies between *Trip. verticillatum* Bail.,* *superbum* (Mask.) Nord., and *Trip. gracile*† *bidentatum* f. intermedia Nord. Looked upon as an immature form, it could develop into the former by the teeth becoming bifid verrucae, or into the latter by their lengthening out into aculei. No tendency of the sort has been noticed, however, in any of the specimens that I have observed.

TRIP. GRACILE Bail., *BILOBATUM Turn., Alg. E. India, p.26, T.2, f.4. *Cf.* West (Desm. N. Amer. T.13, f.10-13) especially the end views.

The specimens noted had 10 teeth to the verticil and 17 verticils to the semicell. Also the apices were 4-lobed, each lobe bidentate. I have noticed in other varieties of *Triploceras* the "two intervening spines" mentioned by Turner, l.c., in bilobed apices. It seems probable that such a form is immature, and that the two spines on each side develop into bidentate lobes, thus forming a 4-lobed apex. (*Cf.* T.ii., f 15.)

Long. 444, 530; lat c.ac. 34, 33μ.

Botany.

TRIP. GRACILE Bail., *ACULEATUM Nord., Fr.Alg.N.Z.,T.7, f.13-14, forma AUSTRALICA, n.f. (T.ii. f.14-15).

A forma novizelandica differt cellulis minoribus, semicellulis magis attenuatis, verticillis 8-11 in quaque semicellula.

Long. cell. 276, 300, 430; lat.c.ac. ad bas. 24, 36, 50; lat.s.ac. 20, 18; lat. sub. lob. ap. 11, 11μ.

Botany, Centennial Park.

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* Fr. Alg. N. Z. T.7, f.3.
† l.c. T.7, f.17.

TRIP. DENTICULATUM, n.sp. (T.ii. f.11).

Trip. mediocre, gracillimum, elongatum, 16 plo. longius quam latum. Semicellulae e basi ad apices leniter attenuatae; inflationibus rotundatis 11 ornatae; inflationibus seriebus dentium minutorum patentum binis praeditis; apicibus 3 (2-4 ?) lobatis; lobis dentibus minutis singulis (vel binis ?) instructis.

Long. 371; lat. 23μ.

Murray's Lagoon, Collector.

Most like *Trip. (Doc.) occidentale* Turn.,* which, however, has verticils with aculei pointing up and down the cell. Compare also Wolle (Desm. U. S., *Doc. gracile*, T.10, f.3).

Genus ICTHYOCERCUS West.

IC. AUSTRALIENSIS, n.sp. (T.ii. f.8).

Icth. magnus, gracilis, circ. 15 plo. longior quam latus, medio levissime constrictus. Semicellulae paullulo attenuatae, lateribus rectis, basi leviter inflatae, apice aegre dilatatae angulis in cornua minuta, acuta, productis. Membrana achroa, glabra.

Long. 144; lat. 10μ.

Botany.

This comes very near to *Ic. longispinus* (Borge),* which I cannot consider a variety of *Ic. angolensis*. *Ic. australiensis* is half as long again, inflated at the base, and with tiny horns instead of spines. This is, as far as I know, only the third record of the genus. It is known also from Angola and Guiana. Cf. *Ic. angolensis* West (in Journ. Bot. xxxv. T. 368, f.26-31).

Genus CLOSTERIUM Nitzsch.

CL. MOURENSE, n.sp. (T.ii. f.1).

Cl. permagnum, rectum, fusiforme, diametro circ. 9 plo. longius, utroque polo leniter attenuatum, ventre in medio planum apices versus recurvatum, dorso leniter arcuatum, apicibus subobtusis,

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* 'On some New Desm.', Journ R. Micr. Soc. (2) v. 1885, T.15, f.25

† Trop. u. subtrop. T.2, f.51.

truncatis, paullulo recurvatis. Membrana achroa, glabra, striis nullis. Sutura non evidente.

Long. 844-1140; lat. 106-125μ.

Murray's Lagoon, Collector; Moura.

Cl. libellula Focke, figured by Raciborski,* is the nearest in shape to this species, but it is far too small, and punctate. Cf. also *Cl. lunula* var. *maximum* Borge.† I have no note as to the disposal of the endochrome. *Cl. lunula*, *lanceolatum* and the stout form of *acerosum* are members of this group.

CL. MAGNIFICUM, n.sp. (T.ii. f.3).

Cl. permagnum, elongatum vix arcuatum, diametro circ. 9-12plo. longius, ventre paullulo concavum, dorso leniter curvatum, apicibus subobtusis, truncatis, paullulo recurvatis. Membrana achroa, glabra, striis nullis. Sutura evidente. Long. 800-809; lat. 68-92; alt. (ad dorsum) 110μ.

Lara Dam, Moura.

Most like *Cl. Wittrockianum* Turn.,‡ from which it differs in its greater size, absence of colour and striae, the slightly recurved ends and visible suture. From *Cl. lanceolatum* Kutz., it differs in its larger size, concave ventral margin, and narrower shape.

CL. MOLLE, n.sp. (T.ii. f.12).

Cl. permagnum, arcuatum, cylindricum, elongatum, diametro circ. 13-14plo. longius, ventre regulariter concavum non tumidum, dorso regulariter convexum, ad apices sensim sensimque attenuatum, apicibus subobtusis, rotundatis, incrassatis. Membrana levissime rufescente, subtilissime striata. Sutura evidente. Endochroma obscuro-viride, in laminis longitudinalibus disposita. Vesciculi terminales minimi.

Long. 935-965; lat. 70; alt. 100μ.

Auburn; Moura.

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* Desm. Ciast. T.1, f.44.

† Alg. Regnell. T.1, f.9.

‡ Alg. E. Ind. T.1, f.25.

Cl. molle may be classed with *Cl. decorum* Bréb. (see Wolle, Desm. U. S., T. 7, f.1), *Cl. Wallichii* Turn.,* and *Cl. dilatatum* West.† It is a perfectly tubular form, with beautifully rounded ends, which are not flattened or turned back.

Cl. calamus, n.sp. (T ii. f 4).

Cl. permagnum, valde elongatum, gracillimum, fere rectum, 30-35plo. longius quam latum, paullulo curvatum, utroque polo rapidissime attenuatum, lateribus parallelis, apicibus conicis, subacutis. Membrana subtilissime striata. Endochroma in taenias 4 (3 ?) longitudinales parietales disposita; vesiculo centrali magno, terminalibus minimis. Nuclei amylacei 18 in quaque semicellula.

Long. 1000; lat. 30; alt. 60μ.

Moura.

This species differs from *Cl. acerosum* in its almost parallel sides, from *Cl. praelongum* in its straight ends not recurved at all, and from *Cl. lineatum* in its equal curvature. From all these also it differs in the arrangement of its endochrome in the parietal taeniæ. Along with *Cl. Mourense* I fancy it holds the record for length.

Cl. cornutum, n.sp. (T.ii. f.13).

Cl. parvum, validum, lunatum, 5-6plo. longius quam latum, uno polo ad alterum et ventre et dorso regulariter arcuatum, e sutura ad apices rapide attenuatum, apicibus subacutis. Membrana glabra, lutea. Sutura evidente.

Long. 160; lat. 30; alt. 54μ.

Botany.

Its nearest ally is *Cl. Leibleinii* Kutz., which, however, is larger, swollen in the centre and more curved, but *cf.* Ralfs (Br. Desm., T.28, f.4) and Börgesen (Cent. Braz., T.2, f.7). I have not yet come across *Cl. Leibleinii*, nor did Nordstedt meet with it in New Zealand.

The semicell is almost exactly the shape of a rhinoceros horn.

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* Alg. E. Ind. T.1, f.13.
† N. Amer. Desm. 1896, T.13, f.21.

Cl. cingulum, n.sp. (T.ii. f.7).

Cl. parvum, magis curvatum, filiforme, diametro circa 18 plo. longius, lateribus parallelis, apicibus subacutis.

Long. 90; lat. 5; alt. 30μ.

Moura, in running water.

In outline the nearest to this form is *Cl. Cynthia* var. *curvatissimum* West, (Scott. plankt., T.14, f.3) with which it agrees in length; but that species is striolate and 2½ times as broad. *Cl. cingulum* might be arranged with *Cl. Jenneri* Ralfs, and *Cl. calosporum* Wittr., especially var. β *Brasiliense* Börges., (Desm. C. Braz., T.2, f.5).

Cl. cancer, n.sp. (T.ii. f.16).

Cl. minimum, canceriforme, subcirculare diametro tantum duplo longius; dorso maxime convexum fere conicum; ventre concavum. Semicellulae e sutura ad apices rapidissime attenuatae, apicibus acutis paullo incurvis et in rostra brevia setacea porrectis. Membrana laevis.

Long. 46; lat. 22; alt. 48μ.

Murray's Lagoon, Collector.

I know of no other species with which this form can be classed, but cf. *Cl. cuspidatum* Bail., in Ralfs, T.35, f.11.

? Cl. naviculoideum, n.sp. (T.ii. f.9).

Cl. minutissimum, rectum, fusiforme, diametro circa 15 plo. longius, apicibus acutissimis in rostra brevia setacea porrectis. Membrana glabra.

Long. 75-84; lat. 5-6μ.

Murray's Lagoon, Collector.

There is some doubt in my mind as to whether this is not the diatom *Nitzschia acicularis* Smith, in Br. Diats. q.v.; no size given. The disposition of the endochrome with a central clear space makes it look like a Closterium.

Genus Penium Bréb.

P. gracillimum, n.sp. (T.iii. f.1).

Pen. angustum, elongatum, 8-10plo. longius quam latum, medio sinu acuto minuto vix constrictum, apicem versus levissime attenuatum; apicibus truncatis; lateribus rectis, parallelis. Semicellulae utroque margine denticulationibus 2 minutissimis in partes 3 divisae, denticulationibus non semper perfecte regulariter dispositis. Membrana achroa, longitudinaliter punctato-striata; striis 8-10.

Long 116-156; lat. 15μ.

Coogee.

A near neighbour of *P. margaritaceum* Ehr., see Ralfs, T.25, f.1*e*, and Wolle, Desm. U. S. T.5, f.11, from which its perfectly straight and parallel sides, colourless membrane, and marginal denticulations serve to distinguish it.

P. pachydermum, n.sp. (T.ii. f.6).

Pen. curtum, crassum, cylindraceum, diametro subduplo longius, medio sinu acuto minuto vix constrictum. Semicellulae subconicae, angulis inferioribus rectis, lateribus e basi verticalibus, adscendentibus, tum repente ad apicem convergentibus, apicibus late rotundatis. Membrana achroa, glabra, crassa.

Long. 84; lat. 37μ.

Centennial Park.

The congeners of this species belong to the globose group of large Penium forms such as *P. australe* Rac., *P. lagenaroides* Roy,* *P. cucurbitinum* Biss. β *subpolymorphum* Nord.† The last-named is nearest to it in outline.

P. australe Rac., Desm. Ciast. p.7-8, T.1, f.11. (T.ii. f.5).

Long. 66, 66, 74, 75; lat. 37, 43, 42, 48μ.

Collector, Auburn, Centennial Park.

* Desm. Windermere, T.5, f.6.

† Fr. Alg. N. Z. T.7, f.20.

Omnia specimina apices versus magis attenuata quam forma a cl. Raciborski delineata. Endochroma totae cellulae (ut primo videtur) in lamina quattuor lateralia disposita area vacua centrali in forma crucis reliquente, vero tamen endochroma in taenias 6-8 angustissimas longitudinales ex axi centrali radiantes, ordinata est. Nuclei amylacei singuli magni.

Genus TETMEMORUS Ralfs.

TET. IMMANIS, n.sp. (T.iii. f.5).

Tet. permagnus, 6-8 plo. longior quam latus, a fronte visus oblongus, in medio constrictus, lateribus fere parallelis, apices versus paullo attenuatus, apicibus rotundato-truncatis, incisura profunda lineari extremo ampliato; a latere visus lateribus parallelis sed paullo retusis, apices versus rapide attenuatus, apicibus obtuso-rotundatis. Membrana achroa punctata, punctis in lineis longitudinalibus dispositis.

Long. 364-425; lat. 50-58 μ.

Botany.

It outline somewhat like *T. Brébissonii*, but far exceeding it in size. Cf. also *Tet. penioides* Benn., in Cooke, Br. Desm. T.26, f.2.

TET. GRACILIS, n.sp. (T.iii. f.4).

Tet. parvus, 6-plo. longior quam latus, medio sinu acuto levi vix constrictus, a fronte visus lateribus fere parallelis, ad apices versus aegre attenuatus, apicibus rotundatis, incisura lineari extremo ampliato; a latere visus lateribus parallelis, apicibus rotundatis. Membrana achroa punctata, punctis obscuris in lineis longitudinalibus dispositis.

Long. 102; lat. 18μ.

Coogee.

This form may perhaps be placed near *Tet. laevis*, from which it differs in its evenly cylindrical shape. Front and side views are both like the fig. of *Tet. Brébissonii* in Wolle, T.20, f.1.

Genus SPIROTAENIA Bréb.

SP. OBSCURA Ralfs, Brit. Desm., p.179, T.34, f.2. (T.iii. f.2).

Long. 134; lat. 24μ.

Coogee.

The endochrome is bright green and apparently diffused, but on carefully focussing the surface seven darker very narrow spiral bands may be seen. The spirals are even more longitudinal than those figured by Ralfs, and are decidedly obscure. Terminal vescicles present, but very small.

Genus EUASTRUM Ehr.

EU. ROTUNDUM, n.sp. (T.v. f.20).

Eu. mediocre, subduplo longius quam latum, profunde constrictum sinu lineari. Semicellulae obscure trilobatae, campanulatae; angulis inferioribus leviter rotundatis; lateribus in parte inferiore convexis, in parte superiore concavis; lobo polare angusto, levissime inflato, apice truncato; angulis superioribus rotundatis, incisura lineari. Semicellulae supra isthmum tumore unico, paullo supra tumoribus binis et inter eos scrobiculis singulis instructae; a latere visae, ovatae, crassae, basi lato rotundato, apice conico. Membrana achroa, laevis l. subtilissime punctata.

Long. 59-68; lat. 29-30; crass. 21-24μ.

Botany.

The nearest forms seem to be *Eu. subhexalobum* West,* *Eu. porrectum* Borge,† *Eu. intermedium* Cleve var. *compactum* West,‡ and *Eu. ansatum* (Ehr.) Schm ,§ evidently misnamed, as he cites Ralfs, T.14, f.2.

The basal tumour can only be seen in ¾ face on rolling over. This species in front view is very like an immature form of *Eu. campanulatum* mihi, but the side view is characteristic, as the semicell is remarkably thick for its size, and the upper tumours

* Some Desm. U. S. T.16, f.7.

† Desm. Regnell. T.5, f.8.

‡ Fr. Alg. Ceylon, T.19, f.14-15.

§ Schmidle, Alp. Alg. T.17, f.10.

project at the widest part. Besides, *Eu. campanulatum* always shows five tumours, with careful observation. Cf. also *Eu. obesum* Josh.,* which has no central inflations or scrobicula.

Eu. triangulum, n.sp. (T.iii. f.7).

Eu. magnum, diametro subduplo longius, profunde constrictum, sinu lineari. Semicellulae obscure trilobatae, triangulares; angulis inferioribus obtusis; lateribus rectis in lobum polarem rapidissime convergentibus; lobo polari producto, angusto, apice vix dilatato; angulis superioribus obtuse-rotundatis, apice truncato, incisura lineari extremo ampliato et binis verrucis instructa. Semicellulae tumoribus 3 basalibus, 2 medianis, inter hos scrobiculis singulis majoribus et (paullo infra) minoribus binis; a latere visae anguste-ovatae, basi late rotundato, apice conico. Membrana achroa subtiliter punctata.

Long. 120, 126, 128, 132; lat. 68, 72, 66, 77μ.

Rose's Lagoon, Collector.

The two outer basal tumours have a mammillate appearance, and generally they alone are visible in front view. The form nearest to this is *Eu. latipes* Nord.,† the details of which, however, are quite different.

Eu. dideltoides (Rac.)

Eu quadriceps Nord., var *dideltoides* Rac., Desm. Ciastoni, p.19, T.2, f.31.

Nuclei amylacei 6 in quaque semicellula.

Long. 153, 160, 160, 170, 172, 176, 176; lat. 75, 75, 78, 80, 82, 80, 86; crass. 48, —, 52, —, —, —, 54; lat. lob. pol. —, 32, 27, —, 30, —, 30μ.

Botany, Centennial Park.

Raciborski (l.c.) gives long. 170, lat. 82, lat. isth. 25, lat. lob. pol. 28μ. Cf. *Eu. quadriceps* Nord.‡ It seems to me that this

* Burmese Desm. T.33, f.19.
† Desm. Cent. Braz. T.2, f.9.
‡ Desm. Cent. Braz. T.2, f.5.

form should not have been placed under *Eu. quadriceps* Nord. The only similarity between them is the general outline in front view. In side and end views they are entirely different, as well as in the tumours and scrobiculae. Especially is this noticeable in the polar lobe, from the cruciate form of which *Eu. quadriceps* takes its name. The specimens here figured are certainly *Eu. dideltoides* and were gathered from the same locality as Raciborski's.

EU. LONGICOLLE Nord. β AUSTRALICUM, n.var. (T.iii. f.6.)

Semicellulae basi latiore, diametro tantum subduplo longiores, e basi magis inflatae; collo minus producto; lobó polari paullo magis inflato; semicellulae supra isthmum tumoribus singulis, paullo supra tumoribus 4 instructae, tumoribus exterioribus e margine orientibus, inter interiores scrobicula unica magna. Cetera ut in forma typica.

Long. cell. 140-147; lat. cell. 64-69; lat. lob. pol. 32; lat. coll. 23-24; crass. 36μ.

Botany, Centennial Park.

Cf. Nordstedt, Alg. N. Z., p.33, T.3, f.5.

This form is a member of a well defined group including *Eu. longicolle* Nord. l.c. var. *Himalyense* Turn., Alg. E. Ind., T.23, f.9, var. *capitatum* West, Fr. Alg. Ceylon, T.19, f.24; and three described herein, viz., *Eu. deminutum*, *Eu. bullatum*, and *Eu. campanulatum*, the last of which connects them with the *sinuosum* group. They are almost altogether Australasian at present, their characteristics being a well defined neck, campanulate base, and strongly dilated head.

EU. SINUOSUM Lenor. F. GERMANICA Rac., Desm. Nowe, p.31, T.2, f.10. (T.iii. f.9-10).

Long. 64, 74, 77, 78; lat. 36, 42, 43, 43; lat. lob. pol. 18, 21, 21, 20; crass. 25, —, 21, —μ.

Botany.

I do not feel quite sure that all the specimens included above should be referred to this species, yet they all come from the

same water and agree remarkably in size and markings. The four scrobiculae are arranged three in an equilateral triangle round the fourth. By careful focussing, the tops of the central basal and two upper tumours appear as scrobiculae also; and it will then be seen that the seven are arranged quincuncially—six at equal distances in a circle round the seventh. It is a characteristic feature of this form.

EU. SUBINCISUM Reinsch, Desm. Cape of Good Hope, f.12. (T.iv. f.1)

Long. 29; lat. 23μ.

Murray's Lagoon, Collector.

Reinsch gives long. 22½, lat. 18μ.

EU. DEMINUTUM, n.sp. (T.iii. f.8).

Eu. magnum, elongatum, medio sinu lineari constrictum, 4 plò. longius quam latum. Semicellulae suboblongae, utroque latere excavatae; angulis inferioribus rectis; lateribus e basi verticalibus tum repente convergentibus et in collum longum, angustum adscendentibus; lobo polari valde inflato, latitudine latitudinem basis fere aequante, lateribus rotundatis, apice latissime rotundato, incisura lineari extremo verrucis binis instructa. Semicellulae supra basin tumoribus binis et inter eos scrobiculis singulis praeditae; a latere visae oblongae, basi inflatae, lateribus fere rectis et parallelis, apicibus rotundato-truncatis; a vertice visae subcirculares, regulariter 6 undulatae. Membrana crassa precipue supra basin, grosse scrobiculato-punctata praecipue in lobo polari.

Long. 135-140; lat. 40; lat. lob. pol. 34-36; lat. coll. 22; crass. 33-34μ.

Botany.

A *Eu. longicolli* proximo differt basi angustiore, lobo polari magis inflato, tumoribus paucioribus, et conspectu a vertice visum.

See note on *Eu. longicolle*, supra.

Eu. CUNEATUM Jenn. β SOLUM Nord., Alg. N. Z, p.34, T.3, f.6.

Long. 102-110; lat. 36-38; lat. ap. 18-21; crass. 23-27μ.

Botany.

Some specimens observed differ slightly from Nordstedt's in side view, the lower part being semicircular, protruding a little and *apparently* incrassate. The appearance of incrassation, however, is caused by the folding of the membrane above the isthmus. The basal inflation is hardly visible on rolling over, and not at all otherwise.

Eu. CUNEATUM Jenn. γ BASIVENTRICOSUM, n.var. (T.iii. f.11).

Supra isthmum ventricosum, tumoribus nullis; a latere visae semicellulae conicae, apicibus rotundatis, basi plano, angulis basalibus rectis. Membrana punctata, punctis in lineas longitudinales interdum ordinatis. Cetera ut in forma typica.

Long. 106; lat. 42; lat. ap. 21; crass. 27μ.

Murray's Lagoon, Collector.

A vertice semicellulam non vidi, fortasse undulationibus 4 cruciatim dispositis ut in *Eu. ansatum* Ehr.

It is difficult to find out what the forma typica is in this species. Ralfs, in Brit. Desm. p.90, says, "I have not detected any inflated protuberances;" yet in T.33, f.3, he gives an end view showing at least three tumours. Cooke, in Brit. Desm. p.70, observes "empty frond without inflations," and in T.34, f.6, figures an end view differing from Ralfs' but still with three inflations. Lundell, in Desm. Suec., refers to Ralfs without comment. Raciborkski, however, in Desm. Nowe, p.30, notes the "semicellulae e basi visae late ellipticae, lateribus (4 undulatis) tumoribus 3 humillimis, vix visibilibus praeditae." Of all the forms I have observed, the one described below is the only one that had any tumours at all, and that had five, three basal and two above; and all, as Raciborski says, "very low, scarcely visible."

Eu. CUNEATUM Jenn. δ CONICUM, n.var. (T.iii. f.12).

Gracilius quam forma typica, 3plo. plusve longius quam latum. Semicellulae magis attenuatae, angulis inferioribus superiori-

busque magis rotundatis, lateribus paullulo retusis; tumoribus humillimis vix visibilibus, 3 basalibus, 2 medianis instructae, inter tumores scrobiculis parvis 4; a latere visae anguste elliptico-ovatae, basi late rotundato vel rotundato truncato. Membrana punctata, punctis in lineas longitudinales nonnunquam dispositis.

Long. 120-132; lat. 40-42; lat. ap. 18-21; crass. 27-28μ.

Botany.

The scrobiculae are arranged, three in an equilateral triangle round the fourth; in side view they appear as a very shallow depression. Sometimes only two (one above the other) are visible. The tumours are very low and obscure, especially the two top ones.

Eu. bullatum, n.sp. (T.iii. f.13).

Eu. mediocre, medio sinu lineari constrictum, diametro subduplo longius. Semicellulae trilobatae, supra basin ventricosae, angulis inferioribus obtusis, lateribus e basi lato fere verticaliter adscendentibus paullulo retusis, ad medium versus semicellulae repentissime lateribus in collum curtissimum crassum confluentibus; lobo polari valde inflato, lateribus obtuso-rotundatis apicibus leniter arcuatis, incisura lineari tuberculis nullis; semicellulae tumoribus 3 basalibus et supra juxta marginem 2 instructae; scrobiculis nullis; a latere visae ovatae, basi rotundato-truncato. Membrana grosse punctata, punctis nonnumquam (praecipue lobo polari) in lineas horizontales vel obscure in quincuncem ordinatis.

Long. 77-87; lat. 39-42; lat. ap. 25-28; lat. coll. 18-19; crass. 28μ.

Botany, Centennial Park.

The nearest to this is *Eu. Everettense* Wolle, in Desm. U. S. T.28, f.5, which differs from it in side and end views. They both seem to me to be connected with the *longicolle* group generally, but not with any member in particular. See note on *longicolle*, supra.

Eu. sinuosum Lenor. var. Ceylanicum West, Fr. Alg. Ceylon, T.19, f.16.

Long. 70; lat. 39μ.

Coogee (rarissime).

Exact shape of *Eu. circulare* in Ralfs, T.13, f.5*a*, but a little broader across the middle sinuation, making the basal portion more quadrate. Not much like West's fig., (l.c.) but the scrobiculae are there. West gives the size 70 × 32μ.

EU. CAMPANULATUM, n.sp. (T.iii. f.16).

Eu. mediocre, medio sinu lineari constrictum, diametro circ. subduplo longius. Semicellulae trilobatae, campanulatae, supra basin ventricosae, sursum in collum curtum repente constrictae; angulis inferioribus obtusis; lateribus in parte inferiore convexis inflationibus levibus singulis, in parte superiore (collo) concavis; lobo polari paullulo inflato; angulis superioribus rotundatis; apicibus truncatis; incisura lineari. Semicellulae tumoribus 3 basalibus et supra 2 in serie horizontali cum inflationibus lateralibus ordinatis, praeditae; inter tumores scrobiculis 3. A latere visae elliptico-ovatae, ad apices attenuatae, basi rotundato-truncatae. Membrana subtilissime punctata.

Long. cell. 92, 93, 93, 96, 97; lat. cell. 52, 42, 48, 44, 41; lat. ap. 24, 18, 20, 19, 19; lat. coll. 22, 17, 18, 17, 18; crass. 33, 24, 30, 22, 24μ.

Collector, Botany, Centennial Park.

This species comes to maturity in three stages, all of which are commonly found accompanying one another. The immature forms very much resemble *Eu. ansatum* in outline, and indeed that is the case with several other species of *Euastrum*. In T.iii., figs.14, 15, 16 show the mature and the two young forms, all found in the same water. Other transition forms were noticed, and sometimes fronds formed of two different semicells. It is the connecting link between the *sinuosum* and *longicolle* groups of *Euastrum*.

Forma immatura No.1. (T.iii. f.14).

Forma ad *Eu. ansatum* accedens basi autem latiore, curtior quam forma typica, aegre ventricosa; lateribus sine tumoribus lateralibus; collo non producto; lobo polari non inflato; scrobicula una tantum.

Long. cell. 70-72; lat. cell. 36-38; lat. ap. 16-17; lat. coll. 16-17; crass. 19μ.
Centennial Park.

Forma immatura No.2. (T.iii. f.14, right hand fig.).

Forma longior quam No.1, fere tam lata quam forma typica, magis ventricosa, tumoribus lateralibus incipientibus, lobo polari aegre inflato, collo nondum producto, scrobiculis minoribus carentibus.

Long. 75-78; lat. 36-42; lat. ap. 17-19; lat. coll. 17-19; crass. 22μ.
Centennial Park, Botany.

Eu. COMPACTUM Wolle, Desm. U.S. p.107, T.27, f.28-29. (T.iv. f.3).

Long. 31-36; lat. 24-25; crass. 15-16μ.
Collector.

Eu. UNDULATUM, n.sp. (T.iv. f.2).

Eu. parvum, oblongum, paullo longius quam latum, medio sinu lineari constrictum. Semicellulae cuneatae, truncatae; lateribus levissime convexis, 4-5 crenatis; angulis superioribus in cornua brevia porrectis; apicibus truncatis incrassatis; incisura acuta brevi cuneata. Crenae sunt series granulorum 6-8 transversales, granulis obscuris infra marginem 2-3. Semicellulae tumore unico parvo obscuro vix visibile supra basin instructae. Membrana laevis.

Long 36-44; lat. 25-30; lat. ap. 14-18μ.
Collector.

The granules in the marginal series are difficult to make out, so also the basal tumour, which cannot be seen at all in front view. The nearest form to this is *Eu. denticulatum* Kirch. *β elongatum* Nord., in Alg. N. Z. p.79, from which it differs in its larger size, crenate sides, series of granules and basal tumour. The most mature form observed was 44 × 30μ. Cf. also *Eu. dentic. β strictum* Börges., in C. Braz. T.3, f.18, the sides of which are biundulate only and the granulations scattered, and *Eu.* spec.? Borge, in Sussw. Chlor. N. Russ. T.3, f.39, which is of similar shape and same size.

Genus ARTHRODESMUS Ehr.

AR. ELLIPTICUS, n.sp. (T.iv. f.4-5).

Ar. magnus, subcircularis, medio sinu cuneato, aperto, introrsum rotundato, constrictus. Semicellulae circ. 2¼ plo. latiores quam longae, ellipticae vel subhexagonae; angulis lateralibus obtusis in aculeos singulos productis; aculeis brevibus validis plus minus assurgentibus; a vertice visae late ellipticae, apicibus acuminatis et in aculeos singulos protractis, medio utrinque area incrassata. Membrana punctata, crassa, semper in medio semicellularum (sed non evidente) interdum ubique (aculeis etiam) valde, incrassata.

Long. 42, 44, 48, 48, 48, 52; lat. 66, 65, 57, 60, 60, 70; crass. 24, 28, 26μ.

Rose's Lagoon, Collector; Botany.

The spines are relatively short, almost dentate in young forms, and generally form a continuation of the dorsal margin. The large incrassate spot in the centre of the semicells distinguishes this species from *Ar. convergens*, to some forms of which it is similar in shape and size. The incrassation of the membrane, including the spines, in old specimens is quite a feature of this form. Cf. *Xan. tetracentrotum* Wolle, in W. & G. S., West N. Am. Desm. T.15, f.24; *Ar. incrassatus* Lager., Am. Desm. f.18; *Ar. gibberulus* Josh., in Journ. Bot. 1885, T.254, f.6; and *Ar. curvatus* Turn., Alg. E. Ind. T.12, f.2.

Genus XANTHIDIUM Ehr.

X. OCTONARIUM Nord., Alg. N. Z. p.42, T.4, f.22.

Long. c.ac. 100, 112, 108, 104, 102; lat. c.ac. 85, 78, 90, 88, 82; long. s.ac. 76, 82, 78, 78, 72; lat. s.ac. 60, 58, 56, 54, 56; long. acul. 15, 15, 16, 17, —; crass. 40, 37, —, —, —μ.

Spines $\frac{6+6}{6+6}$ $\frac{6+7}{6+7}$ $\frac{7+7}{7+7}$ $\frac{6+6}{6+5}$ $\frac{6+7}{6+7}$

Botany.

It is truly remarkable that I have never yet come across a specimen with the full eight pairs of spines to the semicell. All

the above, however, were clearly *Xan. octonarium*, as was shown in every case by the size and the central incrassation. Nordstedt (l.c.) gives 118 × 78μ over all as the size of New Zealand specimens, spines up to 20μ long. It is evident that the number of spines is not to be relied on for identification. Where I noted the end view it has been perfectly and broadly elliptic, not at all hexagonal or with truncate apices—this perhaps on account of the specimens being immature. The incrassation is on the inner side of the membrane, and visible in front view.

XAN. COOGEEANUM, n.sp. (T.iv. f.6-7).

Xan. magnum, latum, oblongum, medio sinu lineari extrorsum ampliato constrictum. Semicellulae subhexagonae, supra basin rectangulares; lateribus levissime retusis; angulis inferioribus fere rectis; lateribus e basi lato verticalibus, a medio semicellulae ad apicem convergentibus; apicibus latis, truncatis, processibus 8 concentrice ordinatis, instructis; angulis basalibus et medianis processibus singulis praeditis; infra marginem semicellulae insuper, processibus binis et dentibus acutis singulis, supra isthmum etiam dente unico, ornatae; processus omnes breves, validi et bifidi. A latere visae suboblongae, basi rotundato-truncatae; a vertice late-ellipticae. Membrana dense punctata interdum crassa.

Long. 69-84; lat. 51-60; lat ap. 36-42; long. proc. ad. 12; crass. 36-40μ.

Coogee.

This species belongs to a small Australian group in which the semicell shows a tendency to be three-lobed, the end lobe more or less drawn out. The apex is furnished with processes arranged in a circle, and the lateral lobes with processes in pairs extending in towards the centre of the semicell. Cf. *Xan. bifurcatum* Borge, in Bailey, Bot. Bull. xv., T.14, f.6; *Xan. (Eu.) multigibberum* Nord., Fr. Alg. N. Z. T.3, f.2; and *Xan. pulcherrimum*, below.

XAN. BIFURCATUM Borge, in Bailey, Bot. Bull. xv., T.14, f.6. (T.iv. f.8, 9).

Long. c. proc. 132-250; lat. c. proc. 84-165; lat. coll. 33-60; long. s. proc. 93-220; lat. s. proc. 50-125; long. proc. 15-22μ.

Centennial Park.

The specimen figured shows one semicell undeveloped (fig.9) and the other mature. In the young form the processes are solitary, not in pairs. The endochrome is arranged in 6 parietal fillets.

XAN. PULCHERRIMUM, n.sp. (T.iv. f.10).

Xan. magnum, subduplo longius quam latum, medio sinu cuneato introrsum acuto non lineari, profunde constrictum. Semicellulae cuneatae; basi lato; lateribus levissime retusis; apicibus truncatis leviter retusis; angulis inferioribus in processus geminatos productis et infra marginem insuper processibus singulis; apice processibus 6 concentrice ordinatis, ornato, processubus 4-fidis omnibus. Semicellulae in centro nudae; a latere visae ovatae, apicibus processibus munitis; a vertice late ellipticae, paullo in medio utrinque inflatae; apicibus processibus 3 instructis. Membrana subtilissime punctata. Endochroma in taenias 6 longitudinaliter disposita.

Long. c proc. 257; sine proc. 224; long. proc. ad 22; lat. c. proc. 156; sine proc. 116 : crass. 82μ.

Lara Dam, Moura.

I had at first thought that this species might be the immature form of *X. bifurcatum*, to which class of Xan. it belongs. The young semicell of that species, however, as shown in T.iv. f.9, has the same 3-lobed outline as the mature form, whereas in *X. pulcherrimum* the semicell is decidedly cuneate, and also there are no processes at all in the centre

XAN. HEXAGONUM, n.sp. (T.iv. f.11).

Xan. mediocre, subrectangulare, circ. tam longum quam latum, medio sinu lineari extremo ampliato profunde constrictum. Semicellulae oblongae, subhexagonae; angulis inferioribus fere rectis; lateribus levissime retusis, e basi lato verticalibus tum

repente ad apices convergentibus; apicibus latis truncatis; angulis basalibus medianis apicalibusque dentibus singulis munitis In centro semicellulae tumore glabro, rotundato. A vertice semicellulae oblongae, crassae, regulariter hexagonae; apicibus latis truncatis, angulis in dentes minutos singulos productis; utrinque in medio tumore rotundato instructae. Membrana punctata paullo incrassata.

Long. 54; lat. 45; crass. 33μ.

Rose's Lagoon, Collector.

Most like *X. Chalubinskii* Eich. & Rac., Nowe Gatt. Ziel T.3, f.28.

Compare *X. fasciculatum* var. *perornatum* Nord., Alg. N. Z. T.4, f.23, with which the above coincides in size and somewhat resembles in outline. It differs, however, in the end view most of all, which in *X. hexagonum* is very broad and regularly hexagonal with dentate angles. The tumour is different also, and the spines wanting. The one cell seen was probably mature, since the membrane was incrassate. Cf. also *X. trilobum* Nord., in C. Braz. T.3, f 35, and *X. subtrilobum* West, in Journ. Bot. xxxv., T.368, f.14.

XAN. DECEMDENTICULATUM, n.sp. (T.iii. f.12).

Xan. mediocre, subcirculare, paullo longius quam latum, medio sinu cuneato profunde constrictum. Semicellulae subreniformes, angulis inferioribus rotundatis, lateribus convexis apices versus levissime retusis, apicibus angustis truncatis; semicellulae utroque latere denticulis geminatis 5 munitae, denticulis adscendentibus paullo curvatis in centro tumore verrucoso ornatae; a latere visae circulares; a vertice ellipticae, apicibus rotundatis, utrinque tumore praeditae. Membrana punctata.

Long. 84; lat. 76; crass. 40, long. dent. circ. 3μ.

Ewenmar, Trangie.

Very similar to *X. fasciculatum* β *ornatum* Nord., in Desm. Greenland, f.10, but larger, and the six pairs of subulate spines or straight aculei in the semicell are replaced in this form by ten pairs of small very sharp-pointed teeth, which, with the exception

of the apical ones, are curved in towards the apex of the cell. This large number of teeth, greater even than in *X. octonarium*, and their entirely different shape, seem to me to distinguish this species from all forms of *X. fasciculatum*. The specimen was surrounded by a gelatinous sheath 200μ in diameter. Cf. also *X. superbum* Elfv. forma Borge, in Bail., Bot. Bull. xv., T.14, f.1.

XAN. BOTANICUM, n.sp. (T.iv. f.13).

Xan. minimum, oblongum, tam latum quam longum, medio sinu cuneato profundissime constrictum, isthmo angustissimo. Semicellulae subhexagonae, lateribus brevibus levissime retusis. apicibus latis truncatis, angulis in aculeos singulos longos, inferioribus horizontaliter, superioribus radiatim, productis; in centro tumore rotundato conico ornatae. A vertice ellipticae utroque latere tumore parvo conico instructae apicibus acuminatis in aculeos singulos protractis. Membrana subtiliter punctata.

Long. c.ac. 40; long. s.ac. 27; long. ac. ad. 12 : lat. c.ac. 43; lat. s.ac. 24; lat. isth. 6 : crass. 12μ.

Botany.

The nearest forms to this seem to be *X. simplicius* Nord., Alg. N. Z. T.4, f.26, and *Ar. octocornis* Ehr., cf. Cooke, Brit. Desm. T.47, f.2; also *Ar. longispinus* Borge, Desm. Braz. T.3, f.35, which has no tumour, and *X. controversum* var. *planctonicum* West, Scott. Plankt. T.16, f.2-3, which is twice the size, with the tumour scrobiculate.

Genus STAURASTRUM Meyen.

ST. FORCIPATUM, n.sp. (T.v. f.1).

St. parvum, subcirculare, ad latera profunde excavatum, sinu nullo, isthmo angustissimo, paullo latius quam longum. Semicellulae subellipticae, dorso convexo, depresso; angulis lateralibus subacutis in aculeos breves singulos productis, aculeis assurgentibus; a vertice triangulares, lateribus concavis, angulis acutis leviter inflatis, aculeis singulis munitis. Membrana glabra.

Long. 32; lat. 39; lat. isth. 8μ.

Botany.

Very like certain forms of *St. Dickiei* and *St. dejectum*. See *St. Dickiei* in Wolle, T.40, f.5, var. *circulare* Turn., Alg. E. Ind. T.16, f.5, forma Börgesen C. Braz. T.4, f.42, *St. dejectum* var. *convergens* Wolle, T.40, f.21, and *Ar. hiatus* Turn., l.c. T.11, f.34.

St. ORBICULARE Ehr. β DENTICULATUM Nord., Desm. Cent. Braz. T.4, f.42. (T.iv. f.14).

Forma lateribus ad basin retractis, angulis basalibus interdum denticulis singulis instructis. Membrana valde incrassata praecipue ad angulos et ad apicem, dense punctata. A vertice angulis rotundatis, papillis latis singulis praeditis.

Long. 50-54; lat. 42-50μ.

Botany.

Cf. *St. orb.* β *verrucosum* Wille, Norges Fersk. p.40, T.2, f.26, which is about half the size. The above form is not exactly like either of the two cited, but is like a cross between them. *St. denticulatum* has no papillae at the angles in end view, and *St. verrucosum* does not show the strongly incrassate angles viewed from the front. The tooth from which the Brazilian form takes its name is not always present in Australian specimens either. Nordstedt's fig. (l.c.) works out at 50 × 42μ.

St. PSEUDOBIRETUM, n.sp. (T.iv. f.15).

St. mediocre, fere tam longum quam latum, medio sinu brevi lineari constrictum, isthmo lato. Semicellulae trapezoideae, dorso dimidio quam basi latiores; angulis inferioribus obtusis; lateribus rectis e basi divergentibus; angulis superioribus acuto-rotundatis; dorso levissime arcuato. Anguli superiores granulis obscuris in seriebus obliquis transversalibus 5 ornati; apicibus denticulis binis interdum munitis. Semicellulae a vertice triangulares, angulis acutis leviter inflatis, seriebus 5 transversalibus granulorum ornatis.

Long. 50-54; lat. dors. 52-60; lat. bas. 30-40μ.

Murray's Lagoon, Collector.

The first view reminds one of *Cos. biretum*, of which a var. *triquetrum* with three rounded angles in end view is recorded

from Europe. That species, however, is larger, the granules are not confined to the upper angles, nor are the angles ever bidenticulate at the ends. Moreover the var. *triquetrum* has "sides deeply sinuous" in end view (Cooke, Br. Desm. p.109).

St. varians Rac., Desm. Polon. T.12, f.1; *St. Kjellmanni* Wille, Cooke, l.c., T.54, f.9; and *St. pygmaeum* Bréb., in Boldt. Desm. fr. Grönl. T.2, f.42, are nearest in form to this species, but its end view alone sufficiently marks it off from them all except the last, which is much smaller.

St. tiara, n.sp. (T.iv. f.16).

St. mediocre, ellipticum, paullo longius quam latum, medio sinu aperto cuneato constrictum, isthmo lato. Semicellulae subcuneatae, tiaraformes, dorso altissime convexae et verrucosae, apices versus fere acuminatae; angulis lateralibus acuto-rotundatis granulis in seriebus 3-4 transversalibus ornatis. Semicellulae a vertice quadratae; lateribus aequalibus, levissime concavis, angulis acutis.

Long. 60; lat. 54μ.

Ewenmar Station, near Trangie.

Compare *St. Pringlei* Wolle, T.50, f.25, and *St. validum* West, Desm. N. Amer. 1896, T.16, f.36.

St. cruciforme, n.sp. (T.iv. f.17).

St. magnum, oblongum, tam longum quam latum, medio sinu brevi acutangulo constrictum, isthmo angustissimo. Semicellulae subcuneatae, lateribus supra basin paullo inflatis, dorso truncatae verrucis truncatis emarginatis 4 instructae; angulis superioribus in processus binos, unum horizontaliter, alterum radiatim, productis; processibus 5-denticulatis 3-4-fidis. Semicellulae apud angulum sub processu inferiore granulis singulis et verrucis emarginatis singulis instructae; a vertice triangulares, lateribus rectis intra quemque marginem serie verrucis lunatis 4 et granulis binis apud angulos ornatae; angulis in processus binos protractis.

Long. c proc. 90; long. s. proc. 60; lat. c. proc. 90-102; lat. s. proc. 54μ.

Collector.

The only species really resembling this is *St. Rosei* mihi; but compare also *St. gracile* Ralfs, *β curtum* Nord., C. Braz. T.14, f.53, which has no superior processes; and *St. bibrachiatum* Rein. var. *cymatium* West, Alg. Madag. T.8, f.28, which is only biradiate.

St. cuniculosum, n.sp. (T.iv. f.18).

St. mediocre, ellipticum, latius (cum processibus) quam longum, medio sinu acutangulo levissime constrictum. Semicellulae campanulatae, basi angustissimo, lateribus usque ad medium semicellulae verticalibus, parte superiore semicellulae utrinque in processum producto, dorso late-rotundato leviter verrucoso (vel denticulato), processibus assurgentibus. Semicellulae lateribus glabris, margine processuum inferiore glabro, superiore autem denticulato; a vertice triangulares, lateribus glabris valde concavis, incra quemque marginem serie unica denticulationum, apicibus 3-4-fidis.

Long. 48; lat. c. proc. 65μ.

Botany.

Somewhat like *St. cytocerum* Bréb., in Ralfs, T.22, f.10, in which, however, the rays are twisted; and also like *St. cerastes* Lund, Desm. Suec. p.69, T.4, f.6, but not nearly so verrucose. In end view the sides are quite smooth, and there are only denticulations down the processes. The apices of the processes also have the usual 3-4 teeth. I have seen no four-rayed form. This is not the same as *St. approximatum* West, Fr. Alg. Ceylon, T.22, f.5, a more slender form which also occurs here.

St. sexangulare (Bulnh.) Lund, Desm. Suec. p.71, T.4, f.9.

Forma 5-radiata. Marginibus radiorum inferiorum 3-4 denticulatis. Omnia specimina a me visa immatura fuerunt radiis superioribus nondum formatis.

Long. s. rad. 34, 36, 40, 51, 60; lat. c. rad. 72, 80, 81, 96, 100μ.

Collector; Botany.

Forma 5-radiata immatura, n.f. (Tab.v. f.11).

(*St. stellinum* Turn., Alg. E. Ind. p.119, T.15, f.6).

Forma a vertice visa 5-angulata, angulis in radios longos rectos attenuatos singulos productis; apicibus radiorum 2-3 aculeis, magnis conspicuis munitis; radiorum parte interiore glabra exteriore obscure 3-denticulata. Membrana tenue apicibus radiorum vulgo exceptis.

Lat. c. rad. 75-120μ.

Collector.

Forma 6-radiata Lund., l.c.

Marginibus omnium radiorum 3-4 denticulatis.

Long. c. rad. 63, 67, —, 72, —, —, —; long. s. rad. 48, 50, 52, 60, —, —, —; lat. c. rad. 93, 94, 93, 105, 102, 108, 123μ.

Collector, Botany, Centennial Park.

Forma 7-radiata Lund., l.c.

Unam tantum cellulam vidi; rara.

Lat. c. rad 102μ.

Collector.

Forma 6-radiata, parte interiore glabra processuum puncta-granulis in series transversalibus binis dispositis ornata.

Long. s. rad. 52; lat. c. rad. 93μ.

Forma marginibus processuum superiorum perfecte glabris.

Curiously enough, none of the specimens answered to *β productum* Nord., Alg. N.Z. p.35, T.4, f.1, q.v.; for although a few of the 5-rayed forms did show a truncate produced apex, and were about the size required, yet being immature (the upper rays only just started) it would not have been safe to have referred them to that variety when all the rest belonged undoubtedly to the typical form. The immature 5-rayed form here figured was found as complementary semicell to a more mature semicell showing both upper and lower rays. I have never seen the corresponding 6-rayed form.

St. Sonthalianum Turn., Alg. E. Ind. p.124, T.14, f.27. (T.v. f.2).

Long. 40; lat. 55-56μ.

Botany; Rose's Lagoon, Collector.

Almost exactly corresponding in shape and size with Turner's figure: cf. also l.c. T.16, f.36. The ends of the processes in Aus-

tralian specimens are suddenly turned inwards a little, and the sinus (if sinus it can truly be called) is rounded within.

St. excavatum West, Alg. Madag. p.78, T.8, f.42. (T.v. f.3).

Long. 19; lat. 45μ.
Centennial Park.

St. coralloideum, n.sp. (T.v. f.4).

St. mediocre, paullo latius quam longum, ad latera profunde et late excavata, medio sinu brevissimo acuto constrictum, isthmo angustissimo. Semicellulae supra basin leviter tumidae, dorso leviter convexae, parte superiore in processus rectos, longos, validos productae; processibus utrinque, verrucis (vel spinis coralloideis) in seriebus transversalibus 5 ordinatis, asperrimis; apicibus 4-fidis spinis coralloideis. Inflatione basali seriebus transversalibus binis granulorum ornata. A vertice semicellulae triangulares, angulis protractis 4-fidis, lateribus concavis verrucis vel spinis circa 16 asperrimis, intra margines verrucis in seriebus singulis ordinatis.

Long. 42-48; lat. 50-68μ.

Botany, Centennial Park, Mosman.

This species belongs to that group of rayed Staurastra which have spines or verrucae along the sides in end view. It includes *St. vestitum* Ralfs (?); *St. aculeatum* (Ehr.), see Ralfs, T.23, f.1-2; *St. Sebaldi* Rein., Mittelfr., T.1, f.11; *St. pseudosebaldi* Wille, Norges Desm. T.2, f.30; *St. concinnum* West, Desm. U. S. 1898, T.18, f.7; and *St. Manfeldtii* Delp., Subalp. T.13, f.8-10, the last being the nearest. Cf. also *St. Heimerlianum* var. *spinulosum* Lutk., Desm. Oberöster. T.2, f.17.

St. volans West β elegans, n.var. (T.v. f.5).

Major quam forma typica, basi interdum globoso (sursum inflata) serie unica minutorum granulorum ornato; apicibus interdum truncatis; processibus 8-11 undulatis 2-4-fidis; dentibus vulgo minoribus. A vertice visa et cetera ut in forma typica.

Long. s. proc. 24-27; lat. c. proc. 52-67μ.

Auburn, Sydney Botanical Gardens, Mosman.

A triradiate form is believed to have been noticed. Cf. West, Alg. Madag. p.79, T 9, f.10-11.

ST. ROSEI, n.sp. (T v. f.6).

St. mediocre, medio vix constrictum. Semicellulae oblongae, dimidio latiores (sine proc.) quam longae, dorso levissime concavae fere planae; lateribus e basi haud divergentibus, angulis superioribus fissis et in processus binos, inferiores horizontales, superiores fere verticales productis; processibus longis (diametro semicellulae aequa libus) gracilibus, glabris, denticulationibus medianis magnis singulis (utroque latere) ornatis; apicibus bi-aculeatis. A vertice visae triangulares, angulis in processus longos glabros (denticulation ibus nullis) singulos protractis, apicibus bi-aculeatis, apud quemque angulum processu altero. Membrana laevi.

Long. c. proc. 50; lat. c. proc 62; long. s. proc. 20; lat. s. proc. 15μ.

Rose's Lagoon, Collector.

It is curious that the denticulation on the side of the processes should be visible in front view only; in end view the processes are quite smooth. The nearest species to this seems to be *St. cruciforme* mihi, T.iv. f.17. Cf. also *St. bibrachiatum* Reinsch, var. *cyathiforme* West, Alg. Madag. T.8, f.28*a*. That, however, is only a biradiate form.

ST. MONILIFERUM n.sp. (T.v. f.7).

St. parvum, paullo longius quam latum, medio sinu minuto vix constrictum. Semicellulae oblongae, parte inferiore glabro; lateribus e basi verticalibus, rectis; sursum dilatatae, ellipticae, dorso late rotundatae; angulis lateralibus obtuse-rotundatis seriebus 4 transversalibus granulorum ornatis, sine aculeis vel granulis apicalibus, supra isthmum series granulorum unica. A vertice semicellulae triangulares, lateribus leviter concavis, angulis obtusis, seriebus 4½ transversalibus granulorum ornatis.

Long. 34-36; lat. 27-29; lat. bas. 11μ.

Botany.

This is not a variety of *St. dilatatum*, for in that species, if the underside of the semicell be focussed, 13 vertical rows of granules can always be counted; the form above has only nine. Nor can it be a form of *St. tricorne*, which has four granules close together in a square at the extreme end of the lateral angle and which appear plainly as minute teeth in front and end views. Including the apical four, that also has 13 vertical series. In the mature form of any species the little details of ornamentation (such as number and arrangement of granules, verrucae, etc.) are remarkably constant and afford the best clue to identification in some cases. See note to *St. campanulatum*, below.

ST. CAMPANULATUM, n sp. (T.v. f.8).

St. minutum, tam longum quam latum, medio sinu minimo constrictum. Semicellulae campanulatae, supra basin levissime inflatae; lateribus paullo sinuatis; dorso plano; angulis superioribus in processus singulos horizontaliter productis, processibus brevibus apicibus rotundatis interdum denticulis binis minutis praeditis. A vertice visae triangulares lateribus concavis, angulis subacutis, apicibus rotundatis, granulis minimis in seriebus transversalibus 6 ornatis.

Long. = lat. 27-32μ.

Rose's Lagoon, Collector.

This form is to be classed with *St. striolatum* Näg., Einz. Alg. T.8, f.A3; and *St. dilatatum* Ehr. var. *insigne* Rac., Desm. Ciast. T.2, f.13, both of which are also known here.

ST. PATENS Turn., Alg. E. Ind. p.108, T 14, f.21, forma AUSTRALICA, n.f. (T.v. f.9).

Forma minor, a fronte visa ut a Turner l.c. delineata, aculeis autem plerumque ternis. A vertice visa triangularis, lateribus levissime concavis fere rectis, angulo quoque repente constricto et in tubulum brevem, truncatum triaculeatum producto; area centrali granulis geminatis in seriebus 3 concentrice ordinatis et angulos versus granulis binis ornata. Semicellulae interdum alternantes.

Long. 30-54; lat. 40-60μ.

Rose's Lagoon, Collector; Botany; Mosman.

All specimens seen had the angles constricted and drawn out into a short tube. The biaculeate form with inflated angles in end view is probably immature. The granules in end view are roughly indicated in Turner's figure; they mark the corners of the truncate end, and the inflated portion of the processes.

St. TRIDENTULUM, n.sp. (T.iv. f.20).

St. parvum, paullo latius quam longum, medio sinu acutangulo constrictum, isthmo angustissimo. Semicellulae subcuneatae, supra basin leviter inflatae, dorso planae, angulis superioribus aculeis geminatis et supra spinis longioribus singulis radiatim, instructis. A vertice visae triangulares, lateribus levissime concavis, angulis acutis in aculeos singulos productos. Membrana glabra. Endochroma laminis geminatis 3 radiantibus disposita. Nuclei amylacei singuli.

Long. 24; lat. 30μ.

Botany.

Cf. *St. Libeltii* Rac., Desm. Nowe, p.28-29, T.3, f.12; *St. avicula* Bréb., in Ralfs, T.23, f.11; and *St. subcruciatum* C. & W., in Cooke, T.51, f.3.

St. AGGERATUM, n.sp. (T.iv. f.21).

St. parvum, suboctagonum, paullo latius quam longum, medio sinu angustissimo (vel lineari?) profunde constrictum, isthmo angustissimo. Semicellulae subhexagonae, supra basin leviter tumidae; dorso altissime convexae; apicibus truncatis; lateribus sursum fere rectis denticulationibus ternis ornatis; angulis lateralibus denticulis brevibus singulis munitis, denticulis parallelis (interdum convergentibus). A vertice visae triangulares, lateribus leviter concavis, angulis inflatis acutis in denticulos singulos productis et granulis obscuris in seriebus transversalibus 2-3 ornatis. In area centrali granulis 6 concentrice dispositis. Membrana glabra.

Long. 28; lat. 30μ.

Botany.

Compare *St. furcatum* Bréb. var. *aculeatum* Schm., Hedw. 34, 1895, f.19; *St. Reinschii* Roy, in Cooke, T.51, f.4; *St. forficulatum* Lund., Desm. Suec. T.4, f.5; and *St. podlachicum* Eich. & Gutw., Alg. Nov. T.2, f.49.

St. Botanense, n.sp. (T.iv. f.19).

St. parvum, tam longum quam latum, medio sinu acutangulo profunde constrictum. Semicellulae subcuneatae vel crateriformes, dorso planae, ventre inflato fere semicirculare, angulis superioribus fissis et in aculeos binos, inferiores horizontales, superiores divergentes, protractis. A vertice visae triangulares, lateribus perfecte rectis, angulis acutissimis aculeis brevibus singulis praeditis. Membrana glabra.

Long. = lat. 30μ.

Botany.

The most closely related form is *St. tridentulum* mihi; see note above.

St. Auburnense, n.sp. (T.v. f.10).

St. minutum, paullo latius quam longum, medio sinu amplo profunde constrictum. Semicellulae subcuneatae vel crateriformes, dorso levissime convexae fere planae, ventre alte convexae; lateribus aegre curvatis fere rectis; angulis superioribus in tubulos singulos radiatim productis, tubulis minimis, brevissimis. A vertice visae triangulares, lateribus medio retusis interdum distincte denticulato-asperis, angulis levissime inflatis et in tubulos singulos productis granulis minutissimis in seriebus transversalibus 4 ornatis.

Long. 18-20; lat. 23-24μ.

Auburn; Rose's Lagoon, Collector.

Forma minor, n.f.

Exacte ut in forma typica sed minor. An granuli nulli?

Long. 12; lat. 16μ.

Botany.

Of similar shape is *St. hexacerum* Wittr. var. *aversum* West, Desm. U. S. 1898, T.18, f.13, but that is granulate irregularly. Compare also *St. tunguscanum* Boldt., Siber. Chlor. T.5, f.22, and

St. apiculatum Bréb., in Cooke, T.49, f.2, which have spines instead of processes; the latter also lacks the lines of minute puncta-granules.

St. assurgens Nord., Alg. N. Z. p.37, T.4, f.8.

Long. 44, 50, 50, 52; lat 84, 87, 92, 80; crass. 20, —, 16, 21μ.

Botany, Centennial Park.

Formae immaturae. (T.v. f.31). (See note below).

Long. 36, 40, 42, 42, 42; lat. 50, 50, 50, 52, 70; crass. 18, —, —, 15, —μ.

Botany, Centennial Park.

All the Australian specimens noted differ a little from Nordstedt's figure, *l.c.*, in the spines at the apex of the rays, which, together with the central swelling in end view, are, as he says, characteristic of the species, even in its young forms. The spines are not sharp-pointed, but blunt and rounded at the tip; the lower (for there are only two prominent) always continues the lower edge of the ray, while the upper widely diverges upwards and outwards. The upper edge of the ray is just a little retuse behind the spines, giving a recurved appearance to the end. If the cell be tilted a little, eight verrucae come into view, sometimes tipped with long spines. A curved row of five granules may be seen in front view running round the base of the central tumour and some way down each ray. Neither these nor the verrucae are conspicuous in the youngest forms. In end view a minute spine can be seen at the base of the terminal spine, on each side; in front they are only visible as granules. The youngest forms are sometimes very convex on the back, more so than in the figure, the rugae smoothed down, and the basal portion of the semicells more or less globose.

I consider *St. indentatum* West, Fr. Alg. Ceylon, T.22, f.10-12, to be an immature form of *assurgens*. He gives size 34-39 × 52-76, crass. 17μ, which tallies exactly with the size of our immature forms given above. The same applies to *St. bicorne* Haupt., in Rac., Desm. Ciast. (from the Centennial Park) T.2, f.8; size 42 × 72μ.

Genus Cosmarium Corda.

Cos. cyclopeum, n.sp. (T.v. f.12).

Cos. parvum, subcirculare, paullo longius quam latum, medio sinu lineari profunde constrictum. Semicellulae subpentagonae, lateribus e basi lato, divergentibus, dorso alte convexae regulariter arcuatae, angulis lateralibus obtusis, apud apices intra marginem granulis singulis vix visibilibus praeditae. A vertice lato-ellipticae, in medio granulis geminatis ornatae, apicibus obtuse-rotundatis. Membrana punctata.

Long. 30-36; lat. 27-32; crass. 18μ.

Murray's Lagoon, Collector.

The nearest form is *Cos. pseudoprotuberans* Kirchn., in Wille, Norges T.1, f.18, which has no apical granule. Cf. also *Cos. Elfingii* β Rac., Desm. Nowe, T.1, f.14, and *Cos. bigemma* Rac., l.c. T.1, f.10.

Cos. incrassatum, n.sp. (T.v. f.15).

Cos. mediocre, suboblongum, paullo longius quam latum, medio sinu cuneato profunde constrictum. Semicellulae regulariter latissime-ellipticae, lateribus late-rotundatis, dorso rotundatae paullulo deplanatae, in medio area incrassata ornatae. A vertice visae ut a fronte, lateribus in medio area incrassata luteola utrinque praeditis. A latere circulares. Membrana glabra.

Long. 42-50; lat. 36-42; crass. 21-25μ.

Botany, Centennial Park.

Like a large edition of *Cos. ellipsoideum* Elfv. (see Rac., Desm. Polon. T.10, f.9). Cf. also *Cos.* (*phaseolus* Bréb. γ) *achondrum* Boldt., Sibir. Chlor., T.5, f.7.

Cos. quadrigemme, n.sp. (T.v. f.13).

Cos. parvum, subquadratum, tam longum quam latum, medio sinu lineari profunde constrictum. Semicellulae subreniformes; basi lato, plano; dorso deplanato-rotundato; angulis inferioribus fere rectis; lateribus interdum paullo divergentibus, angulis superioribus late-rotundatis, ad apices intra marginem granulis 4 (medianis validioribus, exterioribus minoribus et obscuris) in

serie horizontali paullulo arcuato ordinatis, ornatae. A vertice visae ellipticae granulis geminatis utrinque instructae. Membrana minute punctata.

Long. 22-24; lat. 22-25; crass. 12-15μ.

Murray's Lagoon, Collector.

Cf. *Cos. pseudotaxichondrum* Nord. var. *Africanum* West, Journ. Bot. xxxv., T.367, f.14; and *C. heterochondrum* Nord., De Alg. Batav. T.1, f.3.

Cos. VICENISTRIATUM, n.sp. (T.v. f.16).

Cos. parvum, subquadratum, circa tam longum quam latum, medio sinu lineari profunde constrictum. Semicellulae subreniformes, basi lato, plano; dorso truncatae, angulis inferioribus obtusis; lateribus late rotundatis; angulis superioribus obtusis; granulis circa 20 in seriebus radiantibus ubique trans marginem ordinatis ornatae; granulis 2-3 intra marginem; supra isthmum leviter inflatae. A vertice visae ellipticae, in medio utrinque inflatae, apicibus late rotundatis. Nuclei amylacei singuli.

Long. 21-27; lat. 18-27; crass. 15μ.

Rose's Lagoon, Collector; Botany.

Young forms have the sides of the semicells converging to the broad truncate apex, not broadly rounded, and fewer lines of granules across the margin. Cf. *C. striatum* and *C. jenisejense* Boldt., Sibir. Chlor. T.5, f.9 and 13; also *C. polonicum* Rac. var. *alpinum* Schm., Alp. Alg. T.15, f.21.

Cos. FLUVIATILE, n.sp. (T.v. f.18).

Cos. parvum, subovale, paullo longius quam latum, medio sinu lineari extremo ampliato profunde constrictum. Semicellulae subreniformes a basi lato ad apicem attenuatae; angulis inferioribus obtusis; lateribus leviter convexis convergentibus sub apicem paullo retusis; apicibus angustis, truncatis; granulis obscuris in seriebus 3 trans margines laterales ordinatis, granulis intra marginem 2; supra isthmum granulis validioribus geminatis ornatae. A vertice visae ellipticae utrinque in medio granulis geminatis praeditae; apicibus obtusis, granulis in seriebus 3-4 transversalibus ornatis. Membrana subtilissime punctata.

Long. 33; lat. 27μ.

Auburn.

A few somewhat similar are *Cos. bivertex* Rac., Desm. Nowe, T.1, f.20; *Cos. isthmochondrum* var. *brasiliense* Borge, Desm. Regnell. T.2, f.21; *C. limnophilum* Schm., Alp. Alg. T.15, f.20. The nearest approach is *C. Pilgeri* Schm., Aus. Braz. T.4, f.13, which curiously enough is exactly the same size. It has, however, five strongly marked granules on each side; and Schmidle expressly says "seen from above elliptical and not tumid." The above has three rows of almost invisible minute granules across the edges, just sufficient to cause three slight denticulations on the margin. The two large granules are conspicuous in end view.

Cos. JENISEJENSE Boldt. β AUSTRALE, n.var. (T.v. f.14).

Forma dorso depressa fere plana; angulis inferioribus obtusis fere rectis; lateribus verticalibus leniter convexis; angulis superioribus late rotundatis; puncta-granulis in series et verticales circ. 10 (granulis circ 7) et oblique transversales ordinatis, ornata; in centro tumore humili granulis 9 majoribus in series 3 verticales ordinatis, instructa. A vertice visa elliptica utrinque in medio tumore parvo 3-granulato praedita, apicibus late rotundatis.

Long. 35; lat. 26-29; crass. 18μ.

Murray's Lagoon, Collector.

Cf. Boldt., Siber Chlor. T.5, f.13.

Cos. ORTHOPUNCTULATUM Schm., Alp. Alg. T.15, f.15. (T.v. f.27-28).

Forma semicellulis a fronte visis perfecte ellipticis.

Long. 30-34; lat. 34; crass. 15-17: zygo. s. ac. 15; c. ac. 30μ.

Coogee.

Cos. MURRAYI, n.sp. (T.v. f.19).

Cos. parvum, suboblongum, clepsydraforme, paullo longius quam latum, medio sinu breve lineato constrictum. Semicellulae subpyriformes, ad apices versus inflatae; dorso lato truncato paullulo producto; lateribus e basi angusto divergentibus, sursum convexis. A vertice visae regulariter ovales, apicibus late rotundatis. Membrana achroa glabra.

Long. 27; lat. 23; crass. 14μ.

Murray's Lagoon, Collector.

Cf. *Cos. pyriforme* Nord., Cent. Braz., frontispiece, which in general outline it very much resembles. That species is, however, very much larger, long. = 63μ.

Cos. COLLECTORENSE, n.sp. (T.v. f.17).

Cos. parvum, oblongum, dimidio longius quam latum, medio sinu lineari extremo ampliato profunde constrictum. Semicellulae perfecte quadratae; angulis acute-rotundatis; lateribus 3-crenatis; dorso truncatae. A vertice ellipticae utrinque in medio inflatione parva instructae, apicibus rotundatis. A latere ovatae, basi angusto, apice rotundato, lateribus fere rectis e basi divergentibus. Membrana glabra.

Long. 32; lat. 22; crass. 15μ.

Murray's Lagoon, Collector.

The nearest is *Cos. tetragonum* Näg., Einz. Alg. T.7, f.A5, especially f. *polonica* Eich. & Gutw., Alg. Nov. T.5, f.28.

Cos. LATEREPROTRACTUM, n.sp. (T.v. f.23).

Cos. minimum, subquadratum, paullo latius quam longum, medio sinu lineari extremo ampliato profunde constrictum. Semicellulae late subreniformes, depressatae, supra basin inflatae, ad apices attenuatae; dorso lato truncato. A vertice visae angustae, elongato-ellipticae; lateribus fere parallelis; apicibus subacute-rotundatis. Membrana glabra.

Long. 14; lat. 20; crass 6μ.

Rose's Lagoon, Collector.

The only one at all like the above is *Cos. subdepressum* West, N. Amer. T.15, f.15, which is reniform and minutely granular.

Cos. QUADRIFARIUM Lund. forma HEXASTICHA (Lund.) Nord., in Alg. N. Z. p.49.

Forma MAJOR Nord., l.c.

Long. 57-62; lat. 41-46μ.

Forma ROSACEA, n.f.

Forma paullo major, margine verrucis emarginatis 24 instructo; tumore majore verrucis 28 (14 + 10 + 4) ornata.

Long. 74; lat. 57μ.
Botany.

Forma OCTASTICHA Nord., l.c.

Long. 56; lat. 48μ.
Coogee.

COS. PSEUDOPACHYDERMUM Nord., Alg. N. Z. p.53, T.5, f,20. (T.v. f.21).

Long. 110-116; lat. 72μ.
Murray's Lagoon, Collector.

Formae immaturae. (T.v. f.22).

(= *Cos.* ad *obsoletum* accedens, Nord., l.c. f.22 ?).
Long 75, 78, 80, 84, 90, 90, 90, 102; lat. 66, 66, 68, 72, 62, 66 68, 72μ.
Nuclei amylacei bini.
Collector; Auburn.
None of the immature forms observed showed any signs of teeth at the basal angles. On the other hand most, if not all, had a strongly incrassate yellow membrane with the characteristic incrassate papilla within the apex. One at least was noticed with the angular outline on the back, familiar in *C. obsoletum* and *C. perforatum*. The end view of these forms, however, is not a sharp-pointed ellipse, but oblong with broadly rounded ends. I think it highly probable that the two doubtful forms of *Cos. pyramidatum*, in Borge, Desm. Braz. p.94, T.3, f.8-9, are really *Cos. pseudopachydermum* and one of the above immature forms.

COS. VENUSTUM Bréb. β *induratum* Nord., Alg. N Z. p.57, T.3, f.13. (T.v. f.24).

Long. 30, 31, 32, 33; lat. 21, 19, 22, 21; crass. 11, —, —, 11μ.
Collector.

Forma *incognita*: forma immatura No.1. (T.v. f.25).

Long. 18; lat. 13μ. Nuclei amylacei singuli.
Collector.

Forma *trilobata* : Forma immatura No.2. (T.v. f.26).

Nonne *Cos. trilobulatum* Reinsch (?).

Long. 27, 24, 27; lat. 16, 17, 18; crass. —, 9, —μ.

Collector.

Forma incognita is certainly a young form of f. trilobata, as a semicell of each was found forming one frond. Also an intermediate form was noted between f. trilobata and *C. induratum* typicum. Nordstedt's fig. of *C. trilobulatum β basichondrum* looks, it seems to me, a good deal more like this species than that of Reinsch. Cf. Nordstedt, l.c. T.6, f.11; and Reinsch, Spec. Gen. T.3, f.A2. May not f. trilobata be the same as *Cos. trilobulatum* Reinsch (?). Lundell says, in Desm. Suec. p. 42, "Membrana in centro semicellulae paullum incrassata"; and the size is about the same.

Cos. SUBSPECIOSUM Nord., Desm. Arctoae T.6, f.13.

Long. 48; lat. 34; crass. 22μ.

Coogee; rarissime.

The few specimens seen were, as to shape and size, exactly like the type, save that there were incrassate ridges connecting the granules of the tumour. In one with endochrome the pyrenoid was single, I fancied, but it was somewhat doubtful.

Cos. SUBSPECIOSUM β VALIDIUS Nord., Fr. Alg. N. Z. T.5, f.10.

Long 60, 62, 63, 70, 72, 72, 75, 76, 85; lat. 53, 49, 48, 48, 50, 55, 50, 59, 56; crass. —, —, —, —, 26, —, —, —, —μ.

Collector, Moura, Centennial Park, Coogee.

Nuclei amylacei certissime bini.

In no specimen have I ever seen nine vertical rows of basal granules as in Nordstedt's fig., l.c. The most that could be seen were five-six. These did not fill up the breadth of the isthmus, however, and in the largest single semicells, when tilted, I was just able to discern nine granules across the isthmus, but nothing more.

Forma FONTENSIS, n.f. (T.v. f.29).

Forma paullo minor quam forma typica; tumore basali granulis in series distinctas, verticales 5 et horizontales 5-6 dispositis,

ornato. Granulis tumoris plus minus quadratis, basalibus validioribus et emarginatis. Nuclei amylacei certissime bini.

Long. 56, 60, 63, 64, 64; lat. 45, 50, 50, 48, 50; crass. —, —, —, 34, 30μ.

Fountain in the Sydney Botanical Gardens.

This form bears the same relation to β *validius* that Forma Borge, Desm. Regnell. T.3, f.32, does to *subspeciosum* typicum. The size of the Brazilian form is $46 \times 35 \times 22\mu$, loc. cit. p.101.

Genus STAUROPHANUM Turn.

Freshw. Alg. E. India, 1892, p.195, (Genus *Dichotomum* West, 1896, Trans Linn. Soc. 2nd Ser. Bot. v. p.270).

ST. CRUCIATUM (Wall.) Turn. β ELEGANS (West) f. SYDNEYENSIS, n.f, (T.v. f.30).

Cf. Turner, l.c., T.20, f.20, 21 (*Dich. elegans* West, l.c., T.16, f.33).

Forma corpore paullo longiore et latiore, sine constrictione, lobis ter dichotomis, apicibus non furcatis.

Long. c. proc. = lat. c. proc. = 40; long. s. proc. 18; lat. s. proc. 15μ.

Fountain in the Sydney Botanical Gardens.

There can be no doubt at all, I think, of the identity of these two genera and species. Turner says long = lat. = 48-54μ. West gives long. s. proc. 15; c. proc. 42; lat. s. proc. 12; c. proc. 42μ. Turner has the right of priority.

EXPLANATION OF PLATES II.-V.

Plate ii.

Fig. 1.—*Cl. Mourense*, n.sp. (× 720).
Fig. 2.—*Trip. serratum*, n.sp. (× 720).
Fig. 3.—*Cl. magnificum*, n.sp. ,,
Fig. 4.—*Cl. calamus*, n.sp. ,,
Fig. 5.—*Pen. australe* Rac. ,,
Fig. 6.—*Pen. pachydermum*, n.sp. (× 720)
Fig. 7.—*Cl. cingulum*, n.sp. ,,
Fig. 8.—*Icth. australiensis*, n.sp. ,,
Fig. 9.—*Cl. naviculoideum*, n.sp. (?) ,,

Fig. 10.—*Pl. mediolaeve*, n.sp. (× 720).
Fig. 11.—*Trip. denticulatum*, n.sp. ,,
Fig. 12.—*Cl. molle*, n.sp. ,,
Fig. 13.—*Cl. cornutum*, n.sp. ,,
Fig. 14.—*Trip. gracile* Bail. β *aculeatum* Nord., f. *australica* (× 360)
Fig. 15.— ,, ,, ,, ,, end of another (× 720)
Fig. 16.—*Cl. cancer*, n.sp. (× 720)

Plate iii.

Fig. 1.—*Pen. gracillimum*, n.sp. (× 720)
Fig. 2.—*Spir. obscura* Ralfs (× 360)
Fig. 3.—*Doc. expansum*, n.sp. (× 720)
Fig. 4.—*Tetm. gracilis*, n.sp. ,,
Fig. 5.—*Tetm. immanis*, n.sp. (× 360)
Fig. 6.—*Eu. longicolle* Nord. β *australicum*, n.var. (× 720; side × 265)
Fig. 7.—*Eu. triangulum*, n.sp. ,, ,,
Fig. 8.—*Eu. deminutum*, n.sp. ,, ,,
Fig. 9.—*Eu. sinuosum* Lenor. f. *germanica* Rac. (× 720)
Fig. 10.— ,, ,, another form ,,
Fig. 11.—*Eu. cuneatum* Jenn. γ *basiventricosum*, n.var. (× 720)
Fig. 12.— ,, ,, δ *conicum*, n.var. ,,
Fig. 13.—*Eu. bullatum*, n.sp. (× 720)
Fig. 14.—*Eu. campanulatum*, n.sp., f. immatura (No.1) (× 720)
Fig. 14 (right hand fig.)—*Eu. campanulatum*, n.sp., f. immatura (No.2) (× 720).
Fig. 16.—*Eu. campanulatum*, n.sp. (× 720)

Plate iv.

Fig. 1.—*Eu. subincisum* Reinsch (× 720)
Fig. 2.—*Eu. undulatum*, n.sp. ,,
Fig. 3.—*Eu. compactum* Wolle ,,
Fig. 4.—*Ar. ellipticus*, n.sp. ,,
Fig. 5.— ,, older form ,,
Fig. 6.—*Xan. Coogeanum*, n.sp. ,,
Fig. 7.— ,, younger form (× 720)
Fig. 8.—*Xan. bifurcatum* Borge ,,
Fig. 9.— ,, younger form ,,
Fig. 10.—*Xan. pulcherrimum*, n.sp. (× 360)
Fig. 11.—*Xan. hexagonum*, n.sp. (× 720)
Fig. 12.—*Xan. decemdenticulatum*, n.sp. (× 720)
Fig. 13.—*Xan. Botanicum*, n.sp. ,,
Fig. 14.—*St. orbiculare* Ehr. β *denticulatum* Nord., forma (× 720; end × 265)
Fig. 15.—*St. pseudobiretum*, n.sp. (× 720)
Fig. 16.—*St. tiara*, n.sp. ,, (end × 265)

Lycoperdon lilacinum Berk.—Penshurst (on the ground; E. Cheel; August, 1906).

POLYPORACEÆ.

Polyporus eucalyptorum Fr.—Botanic Gardens, Sydney (E. Cheel; October, 1904). Previously recorded from Gerogery (these Proceedings, 1899, p.447).

Fomes annosus Fr.—Smoky Cape near Trial Bay (F. W. Raffills; October, 1905; No.38). Previously recorded only from Queensland.

Fomes australis Fr.—Centennial Park (on decaying stump; E. Cheel; September, 1901): Smoky Cape near Trial Bay (F. W. Raffills; October, 1905; No.39).

Polystictus sanguineus Mey.—Glenorie (on dead branches of *Melaleuca*; E. Cheel; June, 1903): also Belmore: Smoky Cape near Trial Bay (F. W. Raffills; October, 1905; No.6).

Trametes lactinea Berk.—Kahibah near Newcastle (on fence rails; E. Cheel; September, 1904; No.2).

Hexagonia tenuis Fr.—Peakhurst (on trunk of tree; E. Cheel; July, 1901; No.20). Not previously recorded for New South Wales.

HYDNACEÆ.

Hydnum alutaceum Fr.—Botanic Gardens, Sydney (on dead branches; E. Cheel; July, 1906; No.27). Previously only recorded from Victoria.

THELEPHORACEÆ.

Thelephora pedicellata Schwein.—Carlton (on the ground; A. Green; December, 1902): Botanic Gardens, Sydney (E. Cheel; April, 1903; No.33). Not previously recorded for New South Wales.

Thelephora Archeri Fr.—Centennial Park (on sandy swampy land; E. Cheel; December, 1900; No.30). Not previously recorded for New South Wales.

Stereum lobatum Fr.—Galston (on trunks of trees; E. Cheel; June, 1903): Bulli Pass (E. Cheel; March, 1907).

Cyphella australiensis Cke.—Centennial Park (on dead branches of jasmine; E. Cheel; July, 1901; No.21). Previously only recorded for Victoria.

TREMELLACEÆ.

Hirneola polytricha Mont.—Botanic Gardens, Sydney; on decaying branches of various trees; E. Cheel; March, 1903): Woy Woy (Miss M. Flockton; April, 1907; No.15).

Guepinia spathularia Fr.—Penshurst (on decaying log; E. Cheel; October, 1904, No.34).

PHALLOIDEACEÆ.

Aseröe rubra Labill.—Penshurst (on the ground; E. Cheel; April, 1907).

Lysurus australiensis Cooke & Massee.—Penshurst (on the ground; E. Cheel; October, 1906). For the only other New South Wales record known to me, see Hawkesbury Agric. Coll. Journal, ii., pp. 26, 119.

NIDULARIACEÆ.

Cyathus fimetarius DC.—Toongabbie (on cow dung; J. G. Fletcher; August, 1904; No.5): Penshurst (E. Cheel; March, 1905): Botanic Gardens, Sydney (E. Cheel; March, 1907). Previously only recorded for Queensland.

UREDINACEÆ.

Puccinia malvacearum Mont.—Botanic Gardens, Sydney, and Centennial Park (on Hollyhock leaves; E. Cheel; No.10).

Puccinia chrysanthemi Roze.—Penshurst (on Chrysanthemum leaves; E. Cheel; 1901; No.48).

Puccinia helianthi Schw.—Botanic Gardens, Sydney (on Sunflower leaves; E. Cheel).

HYPOCREACEÆ.

Cordyceps Robertsii Hook.—Auckland, N.Z. (on a caterpillar; W. Gardner; November, 1901).

Sphaerostilbe cinnabarina Ful.—Centennial Park and Botanic Gardens, Sydney (on dead branches of *Pittosporum undulatum*, *Ficus rubiginosa*, and *Aesculus rubicunda*; E. Cheel; May, 1900; No.49).

XYLARIACEÆ.

Poronia oedipus Mont.—Penshurst (on horse dung; E. Cheel; December, 1900; No.18).

[Printed off June 18th, 1907.]

Fig. 17.—*St. cruciforme*, n.sp. (× 720).
Fig. 18.—*St. cuniculosum*, n.sp. ,, (end × 265)
Fig. 19.—*St. Botanense*, n.sp. ,,
Fig. 20.—*St. tridentulum*, n.sp. ,,
Fig. 21.—*St. aggeratum*, n.sp. ,,

Plate v.

Fig. 1.—*St. forcipatum*, n.sp. (× 720)
Fig. 2.—*St. Sonthalianum* Turn. (× 720)
Fig. 3.—*St. excavatum* West ,,
Fig. 4.—*St. coralloideum*, n.sp. ,,
Fig. 5.—*St. volans* West. β *elegans*, n.var. (× 720)
Fig. 6.—*St. Rosei*, n.sp. (× 360)
Fig. 7.—*St. moniliferum*, n.sp. (× 720)
Fig. 8.—*St. campanulatum*, n.sp. (× 720)
Fig. 9.—*St. patens* Turn. f. *australica*, n.f. (× 720)
Fig. 10.—*St. Auburnense*, n.sp. (× 720)
Fig. 11.—*St. sexangulare* Bulnh., f. immatura (× 360)
Fig. 12.—*Cos. cyclopeum*, n.sp. (× 720)
Fig. 13.—*Cos. quadrigemme*, n.sp. (× 720)
Fig. 14.—*Cos. jenisejense* Boldt. β *australe*, n.var. (× 720)
Fig. 15.—*Cos. incrassatum*, n.sp. (× 720; end and side × 265)
Fig. 16.—*Cos. vicenistriatum*, n.sp. (× 720)
Fig. 17.—*Cos. Collectorense*, n.sp. ,,
Fig. 18.—*Cos. fluviatile*, n.sp. ,,
Fig. 19.—*Cos. Murrayi*, n.sp. ,,
Fig. 20.—*Eu. rotundum*, n.sp. ,,
Fig. 21.—*Cos. pseudopachydermum* Nord. (× 720)
Fig. 22.— ,, formae ,,
Fig. 23.—*Cos. latereprotractum*, n.sp. ,,
Fig. 24.—*Cos. venustum* Bréb. β *induratum* Nord. (× 720)
Fig. 25.— ,, ,, ,, f. *incognita*, n.f. (× 720)
Fig. 26.— ,, ,, ,, f. *trilobata*, n.f. ,,
Fig. 27.—*Cos. orthopunctulatum* Schm. (× 720)
Fig. 28.— ,, zygospores (a) young, (b) mature (× 360)
Fig. 29.—*Cos. subspeciosum* β *validius* Nord., f. *fontensis*, n.f. (× 720)
Fig. 30.—*Staurophanum cruciatum* β *elegans* (West) f. *Sydneyensis*, n.f. (× 720)
Fig. 31.—*St. assurgens* Nord., immature forms (× 720).

LIST OF FUNGI

Exhibited by E. Cheel (See p.159).

AGARICACEÆ.

Lepiota dolichaula Berk. & Br.—Centennial Park (on sandy soil; E. Cheel; November, 1901; No. 8). Previously only recorded from Queensland.

Laccaria laccata Berk.—Belmore (on the ground; E. Cheel; July, 1906; No.9).

Lentinus subnudus Fr.—Penshurst (on the ground; E. Cheel; May, 1901; No.12). Previously recorded from South Australia, Victoria, and Queensland.

Lentinus strigosus Fr.—Peakhurst (on dead wood; E. Cheel; September, 1902; No.14).

Pleurotus Cheelii Massee, Kew Bull. 1907, p.122.—Eden, near Twofold Bay (on dead branches; E. Cheel; December,1903; No.7).

Xerotes nigrita Led.—Peakhurst (on dead wood; E. Cheel; October, 1901; No.22). Not previously recorded for Australia.

Schizophyllum commune Fr.—Centennial Park (on trunks of various trees; E. Cheel; August, 1900; Nos. 13 and 42): Leura Falls, Katoomba (A. A. Hamilton; December, 1902): Smoky Cape near Trial Bay (F. W. Raffills; October, 1905).

LYCOPERDACEÆ.

Geaster plicatus Berk.—Centennial Park (on sandy soil; E. Cheel; December, 1900).

Geaster vittatus Kalch.—Botanic Gardens, Sydney (on the ground; E. Cheel; December, 1902).

Geaster saccatus Fr.—Woy Woy (on the ground; Miss M. Flockton; April, 1907).

Lycoperdon australe Berk., forma *major* Massee.—Centennial Park (on sandy soil; E. Cheel; March, 1901; No.11). Not previously recorded.

PEZIZACEÆ.

Humaria granulosa Sch.—Kahibah near Newcastle (on horse dung: E. Cheel; September, 1904; No.3).

STICTACEÆ.

Stictis annulata Cke.—Centennial Park (on dead branches; E. Cheel; February, 1901; No.37).

PHYSARACEÆ.

Physarum leucophaeum Fr.—Centennial Park, Penshurst, and Botanic Gardens, Sydney (on leaves, etc.; E. Cheel; May, 1900).

STEMONITACEÆ.

Stemonitis ferruginea Ehrh.—Leura Falls, Katoomba (on rotten fence rail; A. A. Hamilton; December, 1902): Botanic Gardens, Sydney (E. Cheel; April, 1907). Previously only recorded for Queensland and New Zealand.

For the determination of the species bearing numbers, I am indebted to Mr. G. Massee, of Kew, London.

A REVISION OF THE *THYNNIDÆ* OF AUSTRALIA [*Hymenoptera.*]

Part I.

By Rowland E. Turner, F.E.S.

The difficulty of procuring reliable information as to the sexes of the *Thynnidæ*, as well as their comparatively restricted range, has caused the group to be much neglected. As Australia is the headquarters of the family and many of the species are both conspicuous and numerous as to individuals, it might have been expected that Australian entomologists would have done much work on the group. They have probably been deterred by the difficulties encountered at the outset in the identification of the species, many of the old descriptions, especially Smith's, being insufficient without reference to the types, most of which are in the British Museum or in the Hope Collection at Oxford. These have been consulted for the purpose of the present work. Like most of the groups specially characteristic of Australia, it is most strongly represented in the south, especially in the south-western part of the continent, comparatively few species, and those mostly of small size, being found within the tropics. Beyond the limits of Australia they occur, though apparently sparingly, in New Guinea and the adjacent islands as far as Celebes; also in Fiji and New Zealand. Further off they are well represented in the Southern States of South America, especially in Chili, a few species spreading as far as California, and other North American States. In Europe and Asia they are represented only by a few species of *Methoca* and *Iswara*, neither of which is at all nearly related to our Australian forms; the latter indeed can only be assigned to the family with considerable hesitation. From Africa rather more species are known,

at present mostly belonging to *Methoca*, but Tullgren* has recently described a new genus *Aeluroides* from a female somewhat resembling those of *Aelurus*; and it is probable that further collecting will reveal the existence of other forms. We can see from its range that the group is one of southern origin, affording an example of relationship between the Australian and South American fauna in a group of by no means world-wide range.

A wide field is open to entomologists in revealing the life-history of these insects, of which practically nothing is known as yet. Bakewell reared a specimen from a subterranean pupa of a moth; but one or two of the males of small Queensland species may be taken flying with species of *Bembex* around their nests; and Mr. C. French has bred a large Victorian specimen allied to *Thynnus rufiventris* Guér., from a cocoon closely resembling that formed in rotten wood by the large fossorial wasp, *Salius australasiæ* Sm. These facts point to the probability that many species will be found to be parasitical on other Aculeate Hymenoptera as are the *Mutillidæ*.

The females of most of the species are probably very short-lived, their mouths being in such a rudimentary state that it is hardly likely that they make any use of them for feeding. Although the female is often carried by the male to blossoms, she does not seem to join him in feeding. The female seems to be seized by the male immediately on emergence in many cases.

The large number of species and the great diversity of form existing among them render a considerable difference in their life-histories probable; nor is it likely that in a group in which individuals are so numerous, the species should be at all narrowly limited in their selection of a host.

The extreme variation in the form of the hypopygium renders any observation on the uses to which that part is put valuable. It does not seem to be necessarily connected with any modification of the copulatory armature, nor to be co-related to the

* Arkiv Zool. i. 1904.

pygidium of the female. During coupling the female is carried by the male, apparently for the greater part of the day. When resting or moving on a leaf or flower the female is extended behind the male, both with the under surface against the leaf. During flight the female hangs below the male in a doubled-up position; the mandibles being applied to the basal part of the hypopygium, which is held depressed at right angles to the abdomen of the male and the aculeus, or sometimes the carina beneath the hypopygium, inserted between the maxillæ of the female. Thus it is possible that there may be a connection between the structure of the hypopygium of the male and the mouth-parts of the female. The male of *Diamma* does not carry the female, the former being much the smaller; and in this group the hypopygium is unarmed and the female mouth-parts fully developed. In other genera in which the hypopygium is unarmed the female does not seem to be taken with the male as often as in other species, though some species of *Eirone* seem to form an exception.

The classification of the group is difficult; Guérin and Westwood founded a number of genera, using the mouth-parts more especially. Some of these genera will certainly stand, and all, being founded on careful dissections, are worthy of consideration and should not be sunk hastily. Saussure uses the hypopygium as a basis for his classification, but only forms one new genus: whereas Klug used the mouth-parts and avoided subdivision as much as possible. Smith, unlike previous authors, paid very little attention to classification, practically confining himself to the description of new species. Of late years Ashmead has attempted a more detailed classification of the group, taking the hypopygium of the male and the pygidium of the female as the basis. This basis is open to criticism, for, as has been pointed out above, these parts do not appear to be co-related, so that we cannot expect the two sexes to fall into parallel lines if this basis is used. There should be some connection between the form of the pygidium in the female and the claspers in the male, but the study of the latter organs will require much more material than

is at present available. Ashmead's classification therefore is not likely to be accepted as to the groundwork, though worthy of careful attention. As to detail, however, he is often inaccurate, giving the wrong number of joints in the maxillary palpi of the male *Anthobosca* and in the labial palpi of the male *Elaphroptera*, although Guérin in his description of the genera is quite correct on these points. His identification of the species which he takes as the types of his genera is also very faulty, the true species often differing much from the characters given by him for the genus of which he makes it the type. This is extreme carelessness, and renders it impossible to use some of his new genera, even were the characteristics sufficiently good to stand, as we cannot tell what the type-species really is. The extreme multiplication of genera which is a characteristic of most of Ashmead's work is probably much more inconvenience than assistance to other workers, but on this point opinions may differ. In the genera dealt with in the present paper Ashmead has made little alteration. I am unable to accept his subfamily *Rhagigasterinæ*, which I regret, as in many points it would form a convenient and natural group. My reason for rejecting it is the difficulty of placing the genus *Enteles*, the males of which have always been classed with *Rhagigaster*; whilst the female, except in the six-jointed maxillary palpi, is nearer to Ashmead's *Thynninæ*.

Until really large collections, accurately paired, can be obtained from Western Australia, it seems inadvisable to found large numbers of new genera, though it is not desirable to sink old genera where it can be avoided. Dalla Torre in his great Catalogue has added a number of unnecessary synonyms by sinking all the genera, except *Diamma*, in *Thynnus*.

This paper, it is hoped, will be the first of a series of three or four completing a revision of the known Australian species, amounting, with new species available, to nearly four hundred. It seems hardly necessary to publish full descriptions of all Smith's species, his works being easily accessible; supplementary notes only are therefore given, and full descriptions only in cases in which the original description is worthless.

Many species have been received from Mr. C. French, of Melbourne, also from Mr. G. A. Waterhouse and others. Every facility has been given by the authorities of the British Museum and the Oxford University Museum for the examination of their extensive collections and libraries. Most of the North Queensland species are from the collection of the late Gilbert Turner. My thanks are particularly due to Mr. W. W. Froggatt for the loan of his large collection from all parts of Australia, containing a large number of carefully sexed specimens taken in the field. It was originally proposed, when we placed our collections together, that this should be a joint monograph of the *Thynnidæ*, but pressure of private and official work compelled him to withdraw from active participation.

Key to the Classification of the Genera treated of in this paper.

i. Male smaller than the female.

♂. Mandibles tridentate. Maxillary palpi six-jointed; labial palpi four-jointed.

Labrum transverse. First and second recurrent nervures received by the second cubital cell close together. First cubital cell not divided. Hypopygium unarmed.

♀. Mandibles quadridentate. Mouth-parts perfect and larger than in the male. Subfamily i. DIAMMINÆ.

Genus DIAMMA.

ii. Male larger than the female.

♂. Mandibles bidentate. First and second recurrent nervures received by the second and third cubital cells, the second very rarely interstitial with the second transverse cubital nervure. Division of the first cubital cell marked either by a scar or by a more or less complete nervure.

♀. Mouth-parts smaller than in the males, the maxillary palpi more or less rudimentary, mandibles simple, rarely bidentate. Subfamily ii. THYNNINÆ.

A. ♂. Second recurrent nervure interstitial with the second transverse cubital nervure. Hypopygium broadly and deeply emarginate, without a central spine. Genus 1. ONCORHINUS.

B. ♂. Second recurrent nervure received near the base of the third cubital cell. Hypopygium with a long recurved aculeus. Abdomen elongate.

♀. The maxillary palpi never less than four-jointed.

a. ♂. Epipygium narrow at the apex.
♀. Head quadrilateral, flat. Second abdominal segment without striæ.
a^2. ♂. Clypeus with a raised Λ-shaped carina. Front with a transverse carina.
♀. With a sulca on each side of the head from the eye to the occiput. Maxillary palpi six-jointed. Mandibles usually bidentate. Genus 2. RHAGIGASTER.
b^2. ♂. The frontal carina absent or very faint.
♀. Without lateral sulcæ on the head. Mandibles simple. Maxillary palpi four-jointed. Tarsal ungues simple. Genus 3. RHYTIDOGASTER.
b. ♂. Epipygium truncate or broadly rounded at the apex.
♀. Head small, slightly convex, rounded posteriorly. Maxillary palpi six-jointed, mandibles falcate; second abdominal segment transversely striated. Pygidium vertically truncate, striated. Genus 4. ENTELES.
C. ♂. Hypopygium normal, unarmed.
♀. Head quadrilateral, flat, maxillary palpi four-jointed. Abdomen cylindrical.
a. ♂. Three apical joints of maxillary palpi elongate. Antennæ rather long.
a^2. ♂. Third cubital cell not narrow along the radial nervure. Genus 5. AELURUS.
b^2. ♂. Third cubital cell very narrow along the radial nervure. Subgenus *Lepteirone*.
b. ♂. Three apical joints of maxillary palpi moderately lengthened. Antennæ short. Subgenus *Eirone*,
D. ♂. Abdomen short, subpetiolate. Hypopygium armed. Three apical joints of the maxillary palpi elongate.
♀. Without striæ on the second abdominal segment.
a. ♂. Hypopygium tridentate. Labium and behind palpi smooth.
♀. Head quadrilateral, flat, very broad. Maxillary palpi six-jointed. Genus 6. ARIPHRON.
b. ♂. Hypopygium variable. Head concave beneath, the sides with a long curled beard. Labium and palpi with long hairs at the apex.
♀. Strongly rugose or punctured. Head slightly convex, rounded posteriorly; maxillary palpi rudimentary. Pygidium simple. Genus 7. TACHYNOMYIA.

Subfamily **DIAMMINÆ.**

Males.—First and second recurrent nervures received by the second cubital cell almost together; the division of the first cubital cell unmarked.

Mandibles tridentate, maxillary palpi six-jointed, labial four-jointed. Labrum transverse, very short. Hypopygium unarmed, claspers short and small.

Females.—Much larger than the male, the mouth-parts fully developed and larger than in the male, mandibles stout, quadridentate; palpi as in the male, but larger. Second abdominal segment smooth, without carinæ; pygidium simple.

Genus DIAMMA.

Diamma Westw., Proc. Zool. Soc. London, iii. p.53, 1835(♀).
Tachypterus Guér., Voy. Coq. Zool. ii. 2, p.213,(1830)1839(♂).
Psammatha Shuckard, Trans. Ent. Soc. London, ii. 1, p.68, 1837(♂).
Trachypterus D. Torre, Cat. Hym. viii. 119, 1897 (nec. Guér., Voy. Coq ii. 2).
Diamma Ashm., Canad. Ent. xxxv., 1903.

Ashmead points out that Guérin's paper in the Voyage de la Coquille was not published until 1839, though the date on the title page is 1830. Westwood's name therefore has priority. Characters as in the subfamily. The antennæ of the male are stout and rather short. The ocelli are present in the female.

D. BICOLOR Westw.

Diamma bicolor West., Proc. Zool. Soc. London, iii. p.53, 1835(♀).
Psammatha chalybea Shuckard, Trans. Ent. Soc. London, ii. 1, p.69, 1837(♂).
Tachypterus fasciatus Guér., Voy. Coq. ii. 2, p.217 (1830) 1839 (♂); Guér., Mag. de Zool. xii. 1842(♂).
Tachypterus australis Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.109 n.1, T.2, f.27, 1867(♂).
Tachypterus albopictus Sm., Trans. Ent. Soc. London, 1868, p.237(♂).

The colour of the legs in the males is very variable; the variations in this respect may prove to be local, but as I can detect no differences in females from different localities, I prefer to sink all into one species. I cannot agree with Saussure's remarks on the differences of shape in the thorax and abdomen of the males. I follow other authors in putting the sexes together, having had no personal acquaintance with the species. The large size and brilliant blue colour of the female cause it to be well known to all collectors.

Hab.—Sydney, N. S.W.; Melbourne, Vic.; Adelaide, S.A.; Tasmania

This is the only species of the subfamily in Australia, but one or two males have been described from Argentina which will probably prove to belong to it.

Subfamily **THYNNINÆ**.

Genus ONCORHINUS Shuckard.

Oncorhinus Shuckard, in Grey's Journ. of two Expeditions to N.W. and W. Australia, ii. p.471, 1841.

♂. Clypeus very large, tumid, broadly emarginate at the apex. Labrum much narrowed posteriorly, rounded at the apex. Mandibles bidentate. Maxillary palpi six-, labial four-jointed. Head broader than prothorax; antennæ long, about equal in length to the abdomen, stout and of about even thickness throughout. Prothorax rather short, median segment very short and obliquely truncate from the base. Abdomen of moderate length, a little broader at the third and fourth segments than elsewhere, first segment narrowed to the base. Epipygium broadly truncate at the apex, with a triangular, longitudinally striated prominence at the base. Hypopygium widely and deeply emarginate at the apex, leaving a spine on each side, but without a central apical spine. The second recurrent nervure is interstitial with the second transverse cubital nervure.

Saussure, with doubt, followed by Ashmead, gives the mandibles as tridentate. This is incorrect. I am very doubtful as

to the correct position of this genus, which in some respects shows a relationship to typical *Thynnus*. But until the female is known it cannot be located with any certainty.

O. XANTHOSPILUS Shuckard.

Oncorhinus xanthospilus Shuckard, in Grey's Journ. of two Expeditions to N.W. and W. Australia, ii. p.471, n.34, 1841(♂).

♂. Black; the clypeus, mandibles, a narrowly interrupted line on the anterior margin of the prothorax, the tegulæ, the tibiæ and tarsi, the femora at the apex and a spot on each side of each of the abdominal segments, except the epipygium, yellow. The whole insect closely and finely punctured. Wings hyaline, nervures black. A small yellow spot on the mesopleuræ. Length 28 mm.

Hab.—Albany, Swan River, W.A.

A specimen marked "from Shuckard's collection, almost certainly the type," is in the British Museum.

The female is unknown, but it may possibly prove that *Thynnus gravidus* Westw., will be found to belong to this species, both showing a want of close affinity to other species, and both being of rather unusual size. *T. gravidus* does not seem to be the female of *T. klugii* Westw., as Westwood suggests.

Genus RHAGIGASTER Guér.

Rhagigaster Guér., Voy.Coq.Zool.ii p.213,(1830)1839; Westw., Arc. Ent. ii. 2, p.105, 1844; Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.111, 1867.

♂. Clypeus with a Λ-shaped carina. A transverse carina between the eyes. Maxillary palpi six-jointed, the basal joint short, the others subequal, the labial palpi four-jointed, the labrum transverse, short, sharply narrowed but not truncate posteriorly. Epipygium usually narrow, hypopygium ending in a long recurved aculeus, with or without a spine on each side near the base. Mandibles bidentate.

♀. Head rectangular, with a sulca on each side from the eye to the occiput. Maxillary palpi small but perfect, six-jointed,

labial palpi four-jointed. Mandibles bidentate or simple. Pygidium usually simple, but sometimes the epipygium is narrowly produced at the apex, with two parallel longitudinal carinæ on the disc. Type, *R. unicolor* Guér.

Key to the Species of Rhagigaster.

♂♂. i. Head transverse, not large.
A. Hypopygium tridentate.
a. Apical aculeus produced very much beyond the lateral spines, which are very short.
a^2. With a shining triangular space on the clypeus. Entirely black.
a^3. Angles of the prothorax not prominent.
a^4. The shining space on the clypeus very sparsely punctured. *R. unicolor* Guér.
b^4. The shining space on the clypeus more strongly punctured. *R. unicolor* st. *mandibularis* Westw.
b^3. Angles of the prothorax prominent. *R. unicolor* st. *ephippiger* Guér.
b. Lateral spines of the hypopygium long.
a^2. Abdomen shallowly and sparsely punctured. Wings fusco-violaceous.
a^3. Second recurrent nervure received by the third cubital cell close to the base.
a^4. Median segment truncate, sparsely punctured. *R. auriceps*, n.sp.
b^4. Median segment subtruncate, strongly punctured. *R. fuscipennis*, Sm.
b^3. Second recurrent nervure received at some distance from the base of the third cubital cell. *R. approximatus*, n.sp.
b^2. Abdomen closely and finely punctured. Wings subhyaline. *R. crassipunctatus*, n.sp.
B. Hypopygium without lateral spines.
a. Scutellum truncate at the apex.
a^2. Wings fulvo-hyaline. Robust. *R. fulvipennis*, n.sp.
b^2. Wings hyaline. Slender. *R. elongatus*, n.sp.
b. Scutellum subacute at the apex.
a^2. Wings fusco-hyaline. *R. gracilior*, n.sp.
ii. Head large.
A. Prothorax produced at the anterior angles.
a. Head not produced behind the eyes. Epipygium broadly rounded. *R. obtusus* Sm.

b. Head produced behind the eyes, very large. Epipygium narrowly rounded. *R. reflexus* Sm.

B. Prothorax not produced at the lateral angles. Smooth and shining.

a. Hypopygium without lateral spines. *R. lævigatus* Sm.

b. Hypopygium strongly tridentate. *R. neptunus*, n.sp.

♀♀. i. Head nearly square, with a very narrow sulca on each side, reaching from the eye to the occiput.

A. Thorax and median segment without lateral depressions.

a. Median segment not concavely hollowed.

a². Epipygium broad at the base, shortly and bluntly produced to the apex, with a slight median sulca at the apex.

a³. Black, head with two large ochreous maculæ on the front. *R. unicolor* Guér.

b³. Black, head with two large ferruginous maculæ on the front, mesothorax and median segment ferruginous. *R. unicolor* st. *mandibularis* Westw.

c³. Black, the metathorax and median segment ferruginous. *R. unicolor* st. *ephippiger* Guér.

b². Epipygium narrowly produced, with two subparallel longitudinal carinæ on the disc.

a³. First abdominal segment short, vertically truncate at the base. Thorax black. *R. fuscipennis* Sm.

b³. First abdominal segment longer, narrowed to the base, where it is concavely truncate. Thorax red. *R. auriceps*, n.sp.

c². Epipygium gradually narrowed to the apex.

a³. First abdominal segment produced above at the base over the apex of the median segment. *R. gracilior*, n.sp.

b. Median segment concavely depressed from near the base.

a². The depression of the median segment very slightly concave.

a³. Prothorax fairly long. *R. fulvipennis*, n.sp.

b². The depression of the median segment strongly concave.

a³. Prothorax very short. *R. approximatus*, n.sp.

B. Thorax or median segment with a depression on each side.

a. Median segment with a very shallow depression on each side.

a². Epipygium narrowly produced, with two subparallel carinæ on the disc. *R crassipunctatus*, n.sp.

b². Prothorax with a deep depression on each side near the posterior margin. *R. analis* Westw.

ii. The sulcæ on the head enlarged into broad, shallow depressions.

A. Thorax without depressions.

a. Pygidium simple. *R. lævigatus* Sm.

RHAGIGASTER UNICOLOR Guér.

R. unicolor Guér., Voy. Coq. Zool. ii. 2, p.214, 1830(1839),♂.
R. binotatus Westw., Arc. Ent. ii. 2, p.105, 1844,(♀).
R. binotatus Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.111, 1867,(♂♀).

This is the Sydney form of this widely ranging species. The male has the prothorax narrowed in front, the anterior lateral angles not at all prominent. The carina at the base of the clypeus is well developed and branches near the base, the branches not quite reaching the anterior margin. The clypeus between the branches is shining, sparsely punctured. The wings are more strongly suffused with violet than in the southern forms.

The female has the head longer than wide, slightly rounded at the posterior angles, and the median segment is rather long and not very strongly broadened from the base to the apex. The whole insect is black, except two large luteous spots on the front, which are often confluent. Sometimes the legs are fuscous.

Hab.—Sydney.

R. UNICOLOR Guér. st. MANDIBULARIS Westw.

Rhagigaster mandibularis Westw., Arc. Ent. ii. 2, p.105, 1844 (♂♀); Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.111(♂).

The male differs very slightly from the typical *R. unicolor*, but has the anterior margin of the prothorax more raised and the lateral angles slightly prominent. The shining space on the clypeus, between the carinæ, is more strongly punctured.

The female has the head as broad as long, the posterior margin almost straight, the median segment strongly broadened from the base to the apex, and the spots on the front are ferruginous-red, as are also the mesothorax, median segment, and coxæ.

Hab.—Liverpool, Shoalhaven, Mittagong, N.S.W.; Gippsland, Vic.

Saussure gives Sydney as a locality, but I think he is probably mistaken, though the form occurs a little to the west.

R. UNICOLOR Guér. st. EPHIPPIGER Guér.

Diamma ephippiger Guér., Voy. Coq. Zool. ii. 2, p.235, 1830 (1839) ♀.

Rhagigaster aethiops Sm., Descr. n.sp. Hym. p.175, n.1, 1879(♂).

Thynnus überhorstii D.T., Cat. Hym. viii. 117, 1897(♂).

The male has the anterior lateral angles of the prothorax strongly developed, the carinæ on the clypeus much less prominent than in the typical *unicolor*, and the mesothorax and scutellum more strongly punctured. The wings are hyaline or very slightly tinged with violet.

The female has the head as broad as long, as in *mandibularis*, but it is narrower on the posterior margin. The mesothorax is slightly broader than in *mandibularis* and the median segment shorter and rather wider at the base. The spots on the head are almost or quite absent, and the mesothorax, median segment and the whole of the legs are ferruginous-red.

Hab.—Melbourne, Vic.; Kangaroo Island, Adelaide, S.A.; Albany, W.A.

I do not consider these forms sufficiently distinct to warrant full specific rank, and so have retained them only as geopraphical races.

R. FUSCIPENNIS Sm.

Rhagigaster fuscipennis Sm., Descr. n.sp. Hym. p.175, n.2, 1879(♂).

♂. Clypeus finely punctured, with a median carina branching before the centre, the branches reaching the anterior margin. A carina rounded at the apex between the antennæ, and another, transverse and undulating between the eyes, below the anterior ocellus. Head narrowed posteriorly, strongly punctured. Thorax and scutellum coarsely punctured, the prothorax narrowed anteriorly, the anterior margin slightly raised; the scutellum narrowly truncate at the apex. Median segment strongly punctured at the base, depressed and more finely punctured at the apex. Abdomen sparsely punctured above; segments 2-5 with an impressed transverse line near the base and a slightly raised

smooth space on the sides just before the apical margin, the base of the segments very finely punctured. Abdomen beneath strongly punctured. Epipygium rugulose, smooth and with a median carina and recurved margins at the extreme apex, which is narrowly rounded. Hypopygium tridentate, carinate beneath. Entirely black, wings fusco-violaceous.

♀. Head nearly rectangular, longer than broad, rounded at the posterior angles. with scattered shallow punctures, and a short median frontal sulca; a narrow space above the base of the antennæ longitudinally rugulose, a strong lateral sulca almost touching the inner margin of the eye and extending thence almost to the posterior margin of the head. A few scattered ferruginous hairs, especially near the posterior angles. Thorax with a few shallow punctures, prothorax slightly narrowed anteriorly; median segment obliquely truncate, as broad at the apex as long. First abdominal segment vertically truncate anteriorly, short, sparsely punctured, second segment slightly constricted near the base. the punctures on segments 3-5 closer and more elongate; pygidium rugulose at the base, sharply narrowed posteriorly into a very narrow process slightly widened at the apex, the surface of the process smooth with recurved margins or marginal carinæ A row of golden hairs projecting from the sides of the narrow process. Shining black, antennæ with basal joints ferruginous, the apical joints piceous, a luteous mark on the front on each side extending from the inner margin of the eye to above the base of the antennæ, legs dull ferruginous, apical margins of abdominal segments 3-5, and the apex of the pygidium testaceous. Length 9 mm.

Hab.—Mackay, Q.(♂♀ in cop.).

R. APPROXIMATUS, n.sp.

♂. Clypeus with a median carina from the base, branching at the centre, the branches reaching the anterior margin. A V-shaped carina between the antennæ, and another broadly arched between the eyes. Head, thorax, and scutellum punctured, prothorax narrowed anteriorly, with the anterior margin slightly raised;

the scutellum triangular, very narrowly truncate at the apex. Median segment strongly punctured at the base, truncate and very finely punctured-rugulose at the apex. Abdomen rather sparsely punctured, with an impressed transverse line near the base, and a curved elevation strongly emarginate in the costa close to apical margin of segments 2-5. Epipygium rugose, smooth and with a median carina and recurved margins at the extreme apex, which is narrowly rounded. Hypopygium tridentate, carinate beneath, wings fusco-violaceous. The second recurrent nervure is received by the third cubital cell at about one-third of the distance from the base to the apex, not quite close to the base as in other species of the genus. Length 13 mm.

♀. Head subquadrate, slightly rounded at the posterior angles, very sparsely punctured, a short median sulca between the antennæ, the space above the base of the antennæ densely punctured, and thinly clothed with fulvous pubescence. An almost straight sulca on each side from the inner margin of the eye to the occiput; and a shallow depressed mark on each side of the vertex, very narrowly separated. Thorax and abdomen sparsely punctured; the thorax short, the median segment obliquely truncated from the base, the surface of the truncation very strongly concave. First abdominal segment vertically truncate anteriorly; epipygium elongate, produced near the base at the sides into strong angles, thence narrowed and produced, the disc narrow, raised at the margins into very slight subparallel carinæ; a tuft of golden hairs on each side at the apex. Black; the legs and antennæ fuscous. Length 9 mm

Hab.—Cairns, Q.(♂♀ in cop.).

The male is very near *R. fuscipennis*, and I should have hesitated to describe it had it been taken without the female, which is quite different, especially in the median segment.

R. AURICEPS, n.sp.

♂. Clypeus with a carina from the base to the middle, thence branching, the branches reaching the anterior margin, the enclosed triangular space narrow and rugose, the sides of the clypeus very

finely punctured. Head finely rugulose on the front, shallowly punctured on the occiput, a transverse slightly arched carina between the eyes, and a carina broadly rounded at the apex between the antennæ. Thorax strongly punctured, most sparsely on the disc of the mesonotum. Scutellum broadly rounded at the apex. Median segment truncate posteriorly, rather sparsely punctured on the basal portion, with a small, smooth, shining mark at the extreme base, densely and finely punctured at the apex. Abdomen sparsely and shallowly punctured, a transverse row of very fine punctures, emarginate in the middle, near the apex of each segment. Epipygium rugose, the extreme apex smooth with a median carina, not reaching the apical margin. Hypopygium strongly tridentate, carinate beneath. Entirely shining black, the pubescence on the sides of the clypeus grey, on the centre of the clypeus and head golden. Wings dark violet-blue, fusco-hyaline at the apex, the nervures black. Length 14 mm.

♀. Head subquadrate, slightly longer than broad, rounded at the posterior angles, but not so much produced posteriorly as in *R. fuscipennis*; head punctured, densely just above the base of the antennæ, sparsely elsewhere. A short median sulca on the front between the antennæ. The lateral sulcæ on the head reaching from the eye to the occiput converge more closely on the occiput than in *R. fuscipennis*. Thorax and median segment shining, sparsely punctured. Abdomen shining, finely punctured, the first segment concavely truncate anteriorly, and with a minute tubercle at the base beneath. Epipygium with a narrow shining median elevation, the margins of which form raised carinæ, the sides of which near the apex are clothed with a few long pale fulvous hairs. Shining black, the mandibles fusco-ferruginous; thorax, median segment and legs bright ferruginous-red, the apex of the pygidium testaceous. Length 9 mm.

Hab.—Cairns, Q.(♂♀ in cop.).

Very near *R. fuscipennis*, from which it differs most markedly in the shape of the median segment in the male and of the first abdominal segment in the female.

R. CRASSIPUNCTATUS, n.sp.

♂. Clypeus with a median carina from the base to beyond the centre, finely punctured and covered with cinereous pubescence. A broadly rounded carina between the base of the antennæ and a transverse one, less distinct than in *R. fuscipennis*, between the eyes. Head densely punctured, more shallowly and sparsely on the occiput than on the front. Thorax and median segment densely punctured; the anterior margin of the prothorax very slightly raised, the median segment narrowly truncate at the extreme apex. Abdomen finely and densely punctured, the punctures at the base of the segments very minute. An impressed transverse line near the base, and a raised smooth mark on each side near the apical margin of segments 2-5. Epipygium rugose. Hypopygium tridentate. Abdomen beneath more sparsely punctured than above. Entirely black, the pubescence cinereous. Wings hyaline faintly tinted with fuscous, nervures fuscous. Length 14 mm.

♀. Head large, rectangular, somewhat broader than long, hardly rounded at all at the posterior angles, a short median frontal sulca, the space between the sulca and the eyes longitudinally rugulose. The long sulcæ from the inner margin of the eye to the occiput approach each other as in *R. auriceps*. The vertex is smooth and the clypeus is narrowly emarginate at the apex. Thorax smooth, the truncation of the median segment finely and densely punctured. Median segment broadened from the base to the apex, with shallow depressions on the sides, leaving a slightly raised central subtriangular space. Abdomen sparsely punctured, the punctures elongate; the first segment short and broad, vertically truncate anteriorly, with a minute tubercle at the base beneath and an oblique triangular truncation at the apex. The epipygium is narrowed before the apex, and has a narrow, smooth, median elevation, the margins of which are raised, forming longitudinal, slightly diverging carinæ. Length 11 mm.

Hab.—Mackay, Q.(♂♀ in cop.).

Allied to *R. fuscipennis* Sm., from which it may be distinguished by the densely punctured abdomen of the male, and the shape of the head and sculpture of the median segment in the female.

R. GRACILIOR, n.sp.

♂. Clypeus longitudinally carinate at the base, the carina branching in the centre, the branches enclosing a triangular space reaching to the apical margin, which is emarginate at the apex. A broadly V-shaped carina between the antennæ, and a transverse frontal carina reaching to the eyes. Clypeus punctured, covered with grey pubescence, fulvous between the carinæ. The space between the frontal carinæ rugulose; occiput shining, with large shallow punctures. Thorax shining, sparsely covered with shallow punctures. Scutellum subacute at the apex. Median segment rounded, densely and finely punctured at the base, delicately reticulate towards the apex, with white pubescence on the sides. Abdomen sparsely punctured, the punctures large and shallow, the base of the segments very delicately punctured, beneath more densely punctured; segments 2-6 above with a depressed transverse line near the base, and a raised space at the sides near the apical margin. Epipygium rugose, rather broadly rounded at the apex. Hypopygium without lateral spines, aculeus with a blunt tooth on the upper surface. Black, the mandibles at the apex, and the legs, excepting the coxæ, obscure fuscous. Wings fusco-hyaline, in some specimens almost hyaline. Length 14 mm.

♀. Head longer than wide, rounded at the posterior angles. Clypeus rugulose; front above the antennæ with fine golden pubescence, densely punctured and with a median sulca. A narrow lateral sulca reaching from the inner margin of the eye to the occiput in an almost straight line, the sulcæ not convergent. Thorax sparsely punctured, median segment only slightly broadened posteriorly. Abdomen sparsely punctured, the first segment longer above than beneath, narrowed from the apex to the base, produced at the base above, overlapping the oblique truncation of the median segment, which is clothed with golden

pubescence. Epipygium without carinæ, with a small tuft of golden hairs on each side near the apex. Length 11 mm.

Shining black, the mandibles, except at the apex, the antennæ and legs, ferruginous.

Hab.—Mackay, Q.(♂♀ in cop.).

R. FULVIPENNIS, n.sp.

♂. Clypeus tumid at the base, with a longitudinal carina from the base to the centre, densely clothed with white pubescence, the pubescence on the middle of the anterior margin fulvous; front coarsely, occiput finely rugulose. A transverse carina between, but not touching the eyes, and another rounded at the apex between the antennæ. Thorax densely punctured, scutellum narrowly truncate at the apex; median segment subtruncate, punctured at the base, finely rugulose at the apex. Pubescence on head and thorax fulvous above, grey beneath. Abdominal segments coarsely punctured, more finely at the base of the segments. The segments beneath thinly fringed with long grey pubescence at the apex. Hypopygium without lateral spines. Black, the mandibles at the apex, scape of the antennæ and legs, except the coxæ, ferruginous. Tegulæ testaceous. Wings flavo-hyaline, nervures ferruginous. Length 16 mm.

♀. Head subrectangular, as broad in front as long, slightly produced posteriorly, smooth and shining, with scattered shallow punctures and a short median frontal suture, a narrow space above the base of the antennæ longitudinally rugose, a strong lateral sulca on each side from near the inner margin of the eye to the occiput, the sulcæ moderately straight as in *R. fuscipennis*. Prothorax gradually narrowed to the anterior margin, which is strongly depressed, finely punctured on the depressed portion, then a narrow rugulose space, then smooth with a few scattered punctures to the posterior margin. Median segment short, oblique truncate posteriorly, the truncation covered with very fine punctures. Abdomen shining, with scattered punctures, first segment short and truncate at the base. Pygidium simple, pointed at the apex. Black; mandibles, clypeus, antennæ, a

spot at the anterior angles of the head on each side and the whole of the legs ferruginous. Length 8 mm.

Hab.—Cape York, Q.(♂♀ in cop.).

R. ELONGATUS, n.sp.

♂. Entirely shining black, with thin, short grey pubescence; femora, tibiæ and tarsi dark fuscous. Very slender. Clypeus with a longitudinal carina from the base to the centre, where it branches widely, densely clothed with pubescence. Front punctured-rugulose, a very faint transverse carina below the anterior ocellus and another rather more distinct and arched a little below it. The interantennal carina very indistinct and broadly rounded at the apex; the occiput sparsely and shallowly punctured. Prothorax punctured, the anterior margin slightly raised; mesothorax and scutellum sparsely punctured, the scutellum rather broadly subtruncate at the apex. Median segment and abdomen sparsely punctured, the median segment rounded and narrowed at the apex. Abdominal segments slightly constricted at the base. Epipygium rugose, depressed, subtriangular, narrowly rounded at the apex. Aculeus projecting shortly beyond the epipygium. Wings hyaline, the forewings washed with fuscous, hindwings iridescent. Length 11 mm.

♀. Unknown.

Hab.—Queensland.

Type in Oxford University Museum, ex Coll. Saunders.

R. ANALIS Westw.

Rhagigaster analis Westw., Arc. Ent. ii. 2, p.106, n.8, 1844(♀).
R. nitidus Sm., Cat. Hym. B.M. vii. p.63, n.16, 1859(♀).
Thynnus demattioi D.T., Cat. Hym. viii. 104, 1897(♀).
Thynnus exneri D.T., Cat. Hym. viii. 106, 1897(♀).

♀. Head much longer than broad; front between antennæ strongly emarginate, with a short median sulca; above the base of the antennæ finely and densely punctured; the remainder of the head sparsely punctured. The lateral sulca from the eye does not reach the occiput, and is straight and shorter than in other species of the genus. Thorax sparsely punctured, the prothorax

with a deep depression on each side close to the posterior margin; median segment only slightly widened from the base to the apex. Abdomen subcylindrical, shining, finely punctured, the first segment vertically truncate at the base, without a tubercle at the base beneath. Pygidium elongate, arcuate, simple, without carinæ and rounded at the apex. Shining black; the mandibles, antennæ, clypeus, a spot on each side between the eye and the base of the antennæ, and the legs, ferruginous; the pygidium bright ferruginous-red. Length 11 mm.

Smith mentions a shallow depression on each side of the median segment, which is scarcely visible though the segment is slightly higher in the middle.

Hab.—Western Australia.

R. REFLEXUS Sm.

Rhagigaster reflexus Sm., Cat. Hym. B.M. vii. p.62, n.12, 1859.

♂. Head very large, clypeus with a short Λ-shaped carina. Lateral angles of the prothorax prominent. Epipygium strongly rugulose, narrowly rounded at the apex. The second recurrent nervure is interstitial with the second transverse cubital nervure. Antennæ short and stout.

♀. Unknown.

Hab.—Swan River, W.A.

R. OBTUSUS Sm.

Rhagigaster obtusus Sm., Cat. Hym. B.M. vii. p.62, n.11.

♂. Clypeus with a short Λ-shaped carina at the base, a transverse carina in front of the anterior ocellus, the prominence between the antennæ rounded at the apex. Epipygium broadly rounded at the apex.

♀. Unknown.

Hab.—Adelaide, S.A.

R. LÆVIGATUS Sm.

Rhagigaster lævigatus Sm., Descr.n.sp.Hym.p.176,n.4,1879(♂♀).

♂. The clypeus is carinated, the carina branching just below the base into two, enclosing a triangular space, transversely

rugulose. There is a deep depression at the base of the antennæ, and a median sulca on the prominence between the antennæ. The head is punctured, not narrowed posteriorly. The thorax is smooth with a very few fine and scattered punctures; the prothorax as wide as the head; the scutellum very prominent, its sides and the postscutellum finely punctured and pubescent. Median segment smooth, vertically truncate posteriorly. Abdomen shining, with large shallow punctures, very sparse on the basal segments. First segment truncate at the base, subtubercular above the truncation. Second segment with a tubercle at the base beneath. Epipygium coarsely punctured, carinated in the middle on the apical portion, depressed and slightly produced at the apical margin, with sparse fulvous pubescence. Shining black; tarsi fuscous, spines and ungues ferruginous. Wings fuscous, lighter at apex, brilliantly glossed with purple. Length 25 mm.

♀. Instead of the sulcæ from the eye to the occiput usual in the genus there is a broad longitudinal depression. The clypeus has a median carina.

Hab.—N.W. Australia (Smith); Townsville, Q. (Dodd).

This seems to be a rare species.

R. NEPTUNUS, n.sp.

♂. Head shining, sparsely punctured, more densely above the base of the antennæ; a median frontal sulca from just below the anterior ocellus to the base of the clypeus; clypeus narrow, subtriangular, broadly emarginate anteriorly. Antennæ very short. Thorax highly polished with a few scattered punctures, the prothorax as broad as the head, emarginate in the middle anteriorly; the impressed longitudinal lines on the sides of the mesothorax shallow as in *R. lævigatus* Sm.; the scutellum raised, subtriangular, without punctures; median segment short, vertically truncate, with a few scattered punctures. First abdominal segment obliquely truncate anteriorly. All the segments sparsely punctured, except the epipygium, which is deeply and coarsely punctured. Segments 2-6 with a depressed transverse line near

the base, the basal area without punctures. Hypopygium broad at the base with a central recurved aculeus and two long lateral spines. A deep notch beneath between the first and second segments, the tubercle at the base of the first segment very slightly developed, and no tubercle on the basal margin of the second segment: the segments beneath more strongly punctured than above, the two apical segments more finely and densely than the others. Entirely shining black, the wings fuscous flushed with violet, the nervures black. Length 16 mm.

Hab.—Port Essington.

Type in Oxford University Museum, ex Coll. Shuckard.

Near *R. lævigatus* Sm., but differs by the tridentate hypopygium, the absence of a tubercle at the base of the second abdominal segment beneath, the narrower clypeus and more triangular scutellum.

From beyond Australia one true Rhagigaster has been described.

RHAGIGASTER NOVARÆ Sauss.

Rhagigaster novaræ Sauss., Reise d. Nov. Zool. ii. 1, Hym. p. 112, 1867.

Thynnus heideri D.T., Cat. Hym. viii. 108, 1897.

Hab.—New Zealand.

Apparently allied to *R. unicolor* Guér.

Other species which have been assigned to *Rhagigaster*, but which I do not place either in *Rhagigaster* or in the allied genera *Rhytidogaster* or *Enteles* are:—

R. illustris Kirby (Horn Exped. Pt. 1, 1898) ♂.

R. flavifrons Sm. (Trans. Ent. Soc. London (3), ii. 5, p. 390, 1865) ♀.

R. clypeatus Sm. (Descr. n. sp. Hym. 177, 1879) [♂] identical with *Thynnus coelebs* Sauss. (♀), and with *Thynnus clypearis* Sauss. (♂♀).

Bethylus apterus Fab. (Syst. Piez. p. 238, ♀) is placed by Westwood in this genus; but I do not think "abdomen pilosum" could be applied to any Rhagigaster.

Genus Rhytidogaster, n.g.

♂. Very near *Rhagigaster*, from which it may be distinguished by the absence of the well defined frontal carina between the eyes and by the absence of the long ʌ-shaped carina on the clypeus. Hypopygium without lateral spines.

♀. Head without lateral sulcæ, mandibles never bidentate, maxillary palpi imperfect, four-jointed. Pygidium simple. Tarsal ungues simple, not bifid. Abdomen usually cylindrical. Corresponds to Saussure's *Rhagigaster* Sections B and C. The difference between the females and those of the true *Rhagigaster* seems sufficient to justify their separation, though the males are very near.

Type *Rhagigaster aculeatus* Sauss.

Key to the Species of Rhytidogaster.

♂♂. i. Median segment rounded.
- A. Prothorax produced at the anterior angles.
  - a. Wholly black. Clypeus without a prominent tubercle.
    - a^2. Epipygium rounded at apex.
      - a^3. Apical margins of epipygium reflexed. — *R. alexius*, n.sp.
      - b^3. Apical margins of epipygium not reflexed. — *R. tristis* Sm.
    - b^2. Epipygium truncate at the apex.
      - a^3. Epipygium very narrowly truncate, with a spine on each side near the base. — *R. denticulatus*, n.sp.
      - b^3. Epipygium more broadly truncate, without lateral spines. — *R. bidens* Sauss.
  - b. Clypeus with an acute prominent tubercle near base.
    - a^2. Wholly black. — *R. cornutus*, n.sp.
  - c. Two apical abdominal segments red.
    - a^2. Clypeus with a smooth subtriangular space at the apex enclosed by a carina. — *R. iracundus*, n.sp.
    - b^2. Clypeus with a triangular oblique truncation at the apex.
      - a^3. Tibiæ and tarsi ferruginous-red. — *R. comparatus* Sm.
      - b^3. Legs entirely black. — *R. tumidus*, n.sp.
  - d. Mesopleuræ red. — *R. pugionatus* Sauss.
  - e. Abdomen ferruginous, sometimes marked with black on the disc of the segments. — *R. aculeatus* Sauss.

ii. Median segment obliquely truncate.
- A. Prothorax produced at the anterior angles.
  - a. Prothorax strongly emarginate anteriorly.
    - a^2. Wholly black. — *R. consanguineus*, n.sp.

b. Prothorax not emarginate.
a^2. Two apical segments red. *R. pinguiculus*, n.sp.
B. Prothorax not produced at the anterior angles.
a. Prothorax truncate anteriorly.
a^2. Black, prothorax and mesopleuræ red. *R. prothoracicus*, n.sp.
b^2. Black, abdomen except basal segment ferruginous. *R. breviusculus*, n.sp.

♀♀. i. With a depression on each side of the prothorax near the posterior margin.
A. Median segment without a carina.
a. Median segment trapezoidal, much broadened to the apex.
a^2. Black; the mesothorax, median segment, legs and pygidium ferruginous. *R. pugionatus* Sauss.
b^2. Wholly castaneous. *R. aculeatus* Sauss.
b. Median segment subcylindrical, very little broadened to the apex.
a^2. Black, the legs and margins of the abdominal segments testaceous-brown. *R. tumidus*, n.sp.
B. Median segment carinated.
a. The carina very slightly developed.
a^2. The depression on the prothorax slight and only on the posterior margin. *R. denticulatus*, n.sp.
b^2. The depressions large, almost reaching anterior margin. *R. prothoracicus*, n.sp.
b. Carina very prominent.
a^2. Prothorax rounded anteriorly. *R. breviusculus*, n.sp.
b^2. Prothorax with the anterior angles prominent and toothed *R. alexius*, n.sp.
ii. Without depressions on the prothorax.
A. Head narrow, much longer than wide.
a. Wholly castaneous. *R. bidens* Sauss.
B. Head subquadrate, slightly longer than wide.
a. Shining, abdomen finely punctured.
a^2. Light ferruginous; head, mesothorax and disc of abdominal segments black. *R. consanguineus*, n.sp.
b. Opaque, abdomen longitudinally rugulose.
a^2. Antennæ, legs and two apical abdominal segments ferruginous. *R. comparatus* Sm.
c. The truncation of the median segment concave.
a^2. Wholly castaneous. *R. castaneus* Sm.

R. ALEXIUS, n.sp.

♂. Clypeus densely clothed with white pubescence; head punctured, a carina between the antennæ broadly rounded at the

apex. The anterior margin of the pronotum raised with a groove behind the elevation, broadly emarginate. The thorax punctured, the mesothorax and scutellum most coarsely. Median segment punctured, rounded to the apex. Abdominal segments shallowly punctured; a transverse impressed line, with a row of fine punctures on the basal side of it, near the base, and a raised mark on each side near the apical margin of segments 2-6. Epipygium deeply punctured, the apical margins strongly recurved. Entirely black, with white pubescence. Wings hyaline, primaries faintly fusco-hyaline on the apical third, secondaries iridescent. Length 8-10 mm.

♀. Head quadrate, as broad as long, slightly rounded at the posterior angles, densely and finely punctured, with thin cinereous pubescence, a deep semicircular depression on the middle of the posterior margin. Prothorax short, broader than long, with the anterior lateral angle on each side produced into an acute spine, and a depression on each side of the posterior margin, extending on to the mesothorax. The mesothorax raised in the middle into a rounded subtubercular elevation. Median segment rather short, broadened to the apex, where it is almost vertically truncate, with a broad median carina, and the margins of the segment raised, leaving a deep depression on each side of the median carina. The thorax and median segment shining, sparsely and finely punctured. Abdomen subcylindrical, finely and densely punctured, the punctures on the apical half of each segment elongate. The second and third segments are more densely punctured than the others and are thinly clothed with fine pubescence on the apical half, giving an appearance of longitudinal striæ. Epipygium elongate, strongly deflexed to the apex, with a very slender acute spine at the side near the base, the lateral margins on the apical half of the segment raised into carinæ, the space between them longitudinally striated to the apex, which is narrowly rounded. Black; antennæ, mandibles, legs and abdomen chestnut-brown. Length 6-8 mm.

Hab.—Cape York, Q.(♂♀ in cop.).

R. TRISTIS Sm.

Rhagigaster tristis Sm., Cat. Hym. B.M. vii. p.63, n.13, 1859(♂).
Thynnus hammerlei D.T., Cat. Hym. viii. 108, 1897(♂).

The clypeus has a very short carina from the base, then branching, the space between the branches smooth and shining. A very faint V-shaped carina between the antennæ. Head, thorax and median segment punctured-rugose, most coarsely on the mesothorax and scutellum; the prothorax with the anterior angles slightly prominent; the scutellum narrowly truncate at the apex. Abdomen slender, rugulose, segments 2-5 with a depressed transverse line at the base and a smooth, polished, raised mark on each side near the apical margin. Epipygium coarsely punctured at the base, smooth and rounded at the extreme apex. Black; wings hyaline, iridescent, nervures black. Length 11 mm.

♀. Unknown.

Hab.—Western Australia.

R. DENTICULATUS, n.sp.

♂. Clypeus densely clothed with grey pubescence, with a median carina from the base to the apex. Head rugulose, finely punctured on the occiput. Prothorax rugose, moderately produced at the anterior angles; mesothorax and scutellum coarsely rugose. Median segment very densely punctured, obliquely depressed to the apex. Abdominal segments punctured, with a depressed transverse line near the base and a raised mark on each side near the apical margin of segments 2-5. Epipygium rugose, with a spine on each side near the base, the apex narrowly truncate. Entirely black, legs fuscous. Wings fusco-hyaline, slightly iridescent. Length 11 mm.

♀. Head much longer than broad, rectangular, shining, sparsely punctured. Prothorax very faintly punctured, with a depression on each side, broad and deep on the posterior margin, reaching nearly half-way to the anterior margin, but becoming narrower and less deep. Median segment more strongly punctured, with a faint median longitudinal carina, obliquely truncate at the apex,

broadened from the base. Abdominal segments densely covered with elongate punctures. Pygidium narrow and strongly deflexed at the apex. Abdomen cylindrical. Length 7 mm.

Hab.—Mackay, Q.(♂♀ in cop.).

R. BIDENS Sauss.

Rhagigaster bidens Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.112, n.3, 1867(♂).

Thynnus semperi D.T., Cat. Hym. viii. 115, 1897.

Saussure's description of the male is sufficient. It is a much smaller species than *Rhagigaster unicolor* Guér., and of an opaque black with subfuscous wings; the sculpture is also very different.

♀. Head rectangular, much longer than broad, deeply but rather sparsely sculptured, not very much broader than the prothorax. Prothorax narrowed anteriorly, as broad on the anterior margin as long; mesothorax small, much narrowed posteriorly. Median segment as long as the prothorax, broadened posteriorly and obliquely truncate; thorax and median segment rather shallowly punctured. Abdomen cylindrical, thickly covered with elongate punctures, which are deeper and larger on the three basal than on the apical segments. Pygidium narrowly truncate at the apex. Entirely castaneous. Length 10 mm.

Hab.—Sydney (Coll. Froggatt).

R. CORNUTUS, n.sp.

♂. Clypeus slightly emarginate at the apex, with a longitudinal carina from the base, which terminates in the middle of the clypeus in a very prominent acute tubercle. A V-shaped carina between the antennæ, but no transverse frontal carina. Front strongly, occiput more finely punctured. Thorax strongly and densely, median segment rather more finely punctured and rounded posteriorly. First abdominal segment with a median sulca from the base not reaching the apex; segments 2-5 with a strongly depressed line near the base, and the sides raised near the apical margin forming an emarginate carina almost obsolete

in the centre. The segments finely punctured at the base, more strongly and sparsely near the apex, the two apical segments coarsely punctured. Entirely black; wings hyaline, nervures fuscous, a slight fuscous cloud in the radial cell. Length 11 mm.

Hab.—Australia. Type in British Museum.

Easily distinguished by the prominent tubercle on the clypeus.

R. CASTANEUS Sm.

Rhagigaster castaneus Sm., Cat. Hym. B.M. vii. p.63, n.15, 1859(♀).

Head quadrate, the front longitudinally rugulose, pubescent; the occiput finely and sparsely punctured, without a sulca between the antennæ. Thorax short, the prothorax rather broader than long, punctured sparsely. Median segment short, broadened posteriorly, obliquely truncate, the surface of the truncation concave. Abdomen subcylindrical, finely punctured, the epipygium longitudinally rugulose, rounded at the apex. Entirely castaneous-brown. Length 8 mm.

Hab.—Australia.

R. PUGIONATUS Sauss.

Rhagigaster pugionatus Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.113, 1867(♂).

Thynnus scalæ D.T., Cat. Hym. viii. 115, 1897(♂).

Saussure's description of the male is good. A Tasmanian specimen in my collection is 13 mm. in length.

♀. Head rectangular, a little longer than wide, densely and coarsely punctured, the punctures often confluent, the posterior angles of the head rounded. Prothorax much narrower than the head, narrowed and rounded anteriorly, sparsely punctured, with shallow depressions on the sides near the posterior margin. Mesothorax much broader anteriorly than posteriorly, sparsely punctured with a median, longitudinal, impressed line. Median segment obliquely truncate posteriorly, only half as wide at the base as at the apex, sparsely punctured, the surface of the truncation finely and closely punctured. Abdomen subcylindrical,

coarsely punctured, the punctures elongate, thinly clothed with cinereous pubescence on the sides. Epipygium narrow, deflexed, longitudinally rugulose, rounded at the apex. Black; the antennæ, mandibles at the apex, mesothorax and median segment, and the apex of the pygidium, fuscous; legs dull ferruginous. Length 11 mm.

Hab.—Tasmania.

Specimens from Sydney are much smaller, the male being 10 mm. in length and the female 7 mm. only. The fuscous parts of the Tasmanian female are bright ferruginous in a Sydney specimen, as is also the prothorax.

R. ACULEATUS Sauss.

Rhagigaster aculeatus Sauss., Reise d. Nov. Zool. ii. 1, Hym. p.113, 1867(♂).

Saussure's description is good. The colour varies as to the extent of the black bands on the abdominal segments, which are sometimes wholly black above and sometimes ferruginous.

♀. Unknown.

Hab.—Sydney, Mittagong, N.S.W.; Victoria.

R. ACULEATUS st. ACUTANGULUS, n st.

♂. Differs from the typical form in having the sides of the prothorax nearly parallel and the anterior angles sharply produced. The abdomen is wholly ferruginous except the apical segment, which is black. Length 11 mm.

♀. Head rectangular, much longer than wide, shining, with a few minute scattered punctures. Sides of the prothorax parallel, a small depression on each side of the prothorax near the posterior margin. Thorax and median segment sparsely and finely punctured, median segment as long as the prothorax, twice as broad at the apex as at the base, without a median carina. Abdomen cylindrical, finely and sparsely punctured. Pygidium rounded at the apex Entirely shining castaneous-brown. Length 7 mm.

Hab.—S. Australia. In British Museum collection.

R. BREVIUSCULUS, n.sp.

♂. Head and thorax rugose, the clypeus with a very short carina from the base; antennæ very short. The prothorax is narrowed anteriorly, not produced at the angles. Scutellum short, subtriangular, with a faint carina at the apex. Median segment strongly punctured at the base, obliquely truncate and reticulate at the apex, a faint median carina from the base to the truncation. Abdominal segments closely and very finely punctured, the basal segment and epipygium coarsely punctured. A transverse depressed line near the base and a raised mark on each side near the apical margins of segments 2-5, the extreme apical margins of the segments smooth. Epipygium very narrowly truncate at the apex. Black, opaque, with grey pubescence, the abdomen, except the basal segment, ferruginous. Wings hyaline, faintly iridescent, nervures dark fuscous. Length 10 mm.

♀. Head subrectangular, longer than broad, somewhat rounded at the posterior angles, with elongate confluent punctures and sparse pubescence. Prothorax narrow anteriorly, about the same length at the median segment, with a depression on each side on the posterior margin. Median segment with a broad central carina, the lateral margins slightly raised; obliquely truncate posteriorly. The thorax and median segment sparsely punctured. Abdomen long and cylindrical, delicately longitudinally rugulose. Epipygium pointed, with a delicate median carina. Entirely chestnut-brown, the legs testaceous. Length 7 mm.

Hab.—Mackay, Q.(♂♀ in cop.).

Near *R. aculeatus* Sauss., in general appearance. The form of the median segment and the delicate sculpture of the abdomen are the most marked distinctions in the male. The female differs much from that of the S. Australian form by the prominent carina of the median segment and the sculpture of the abdomen.

R. TUMIDUS, n.sp.

♂. Clypeus tumid, with a faint short carina close to the base, thinly clothed with cinereous pubescence. Head closely punc-

tured, most shallowly on the occiput. Prothorax with the anterior margin straight, the lateral angles very slightly produced. Thorax closely punctured, scutellum rounded at the apex. Median segment very densely and more finely punctured, rounded at the apex. Abdominal segments shallowly punctured, smooth at the base, with a depressed transverse line near the base. Epipygium subtriangular, very narrowly truncate at the apex. Black; the two apical abdominal segments ferruginous-red. Wings hyaline, nervures fuscous. Length 11 mm.

Hab.—Melbourne, Vic.; Swan River, W.A.; Tempe, N.S.W.

This is the species identified by Smith as *Rhagigaster hæmorrhoidalis* Guér., which name, I consider, applies to *R. apicalis* Sm., the male of *Enteles bicolor* Westw.

♀. Head rectangular, slightly rounded at the posterior angles, longer than broad, broader than the thorax, shining, sparsely and shallowly punctured. Prothorax and median segment finely and rather sparsely punctured; the prothorax narrowed and rounded anteriorly, with a small depression on each side close to the posterior angle; median segment rather longer than the prothorax, slightly broadened from the base, obliquely truncate. Abdomen cylindrical, more densely punctured, the punctures confluent. Pygidium pointed. Black; the legs testaceous; antennæ, mandibles and margins of the abdominal segments fusco-ferruginous. Length 5 mm.

R. IRACUNDUS, n.sp.

♂. Clypeus with a prominent carina enclosing a heart-shaped space, which is smooth and shining. Head and thorax punctured, rugose; an obscure carina between the antennæ; the anterior angles of the prothorax very slightly prominent. Median segment finely and densely punctured, rounded posteriorly. Abdomen finely and shallowly punctured, segments 2-5 with a smooth raised mark on the sides near the apical margin and a transverse impressed line near the base of the segments. Epipygium trian-

gular, pointed at the apex. Black; the two apical abdominal segments red. Wings hyaline, nervures fuscous. Length 12-15 mm.

♀. Unknown.

Hab.—Melbourne, Vic. (French).

R. COMPARATUS Sm.

Rhagigaster comparatus Sm., Cat. Hym. B.M. vii. p. 69, 1859 (♂♀).

Rhagigaster rugosus Sm., Descr. n.sp. Hym. p. 176, 1879 (♂nec♀).

♂. The clypeus is carinated at the base, the head and thorax very coarsely rugose, the prothorax and median segment more finely so. The median segment is rounded at the apex. Abdominal segments very finely rugulose, smooth at the base. The tibiæ and tarsi and two apical abdominal segments ferruginous-red. Length 10 mm.

♀. The head is rectangular, longer than broad; head and thorax punctured, the punctures elongate and confluent; the prothorax almost square, shorter than the median segment, which is broadened to the apex and obliquely truncate, the whole abdomen longitudinally rugulose, the pygidium simple, rounded at the apex. Antennæ, legs, and two apical abdominal segments ferruginous. Length 7 mm.

Hab.—Adelaide, S.A; Melbourne, Vic.

Much more coarsely sculptured than in the allied species, and may also be distinguished by the colour of the legs in the male.

The female described by Smith as that of *rugosus* is almost certainly wrongly paired by the collector, and does not belong to this section of the family.

R. PINGUICULUS, n.sp.

♂. Clypeus with a median carina from the base to the centre, where it is widely branched, the apex narrowly emarginate. The carina between the antennæ faint and broadly rounded. Front rugose, occiput strongly punctured. Thorax and median segment at the base coarsely rugose, the median segment short and vertically truncate, the surface of the truncation finely reticulated. Abdomen densely punctured, the apical margins of the segments

smooth, the base constricted. Epipygium more coarsely punctured, narrowly truncate at the apex. The abdomen is shorter and broader than in others of the genus. Black, the two apical segments of the abdomen ferruginous-red; mandibles at the apex, fore tibiæ and tarsi, the calcaria and tarsal ungues, and the apical margins of the five basal abdominal segments fuscous. Wings hyaline, slightly iridescent, nervures black. The clypeus and the sides of the thorax and abdomen with grey pubescence. Length 13 mm.

♀. Unknown

Hab.—Mackay, Q.

R. PROTHORACICUS, n.sp.

♂. Head densely and finely punctured, more sparsely and very finely on the occiput, clypeus clothed with white pubescence, without a carina. Thorax densely and strongly punctured, the prothorax narrowed anteriorly, the angles not produced; the scutellum rounded at the apex. Median segment short, truncated posteriorly, more finely punctured, with long white pubescence on the sides. Abdomen densely and finely punctured, segments 2-5 with a depressed transverse line near the base and a raised mark on each side near the apical margin. Epipygium coarsely rugose, very narrowly truncate at the apex, with a short spine on each side near the base. The aculeus of the hypopygium has an acute spine on the upper surface close to the base. The carina beneath the hypopygium not prominent. Black; the prothorax and mesopleuræ ferruginous-red, the tegulæ dark testaceous, the tarsal ungues testaceous. Wings hyaline, very slightly clouded in the radial cell. Length 11 mm.

♀. Head rectangular, longer than broad, the posterior angles not rounded, densely punctured, clothed with pale fulvous pubescence. Prothorax smooth, rather short, very little narrowed anteriorly, a deep depression on each side, broad on the posterior margin, but not reaching the anterior margin, the lateral margins elevated. Median segment rather sparsely punctured, with a median carina and slightly depressed on the sides, broadened

posteriorly and obliquely truncate. Abdomen cylindrical, finely longitudinally rugulose. Pygidium narrow, arched. Chestnut-brown, the three apical abdominal segments rather darker. Length 8 mm.

Hab.—Mackay, Q (♂♀ in cop.).

R. CONSANGUINEUS, n.sp.

♂. Clypeus with a shining, subpunctured, triangular area, enclosed by slightly raised carinæ. Head without frontal carinæ, densely punctured. Prothorax shallowly punctured, the anterior margin raised with the lateral angles prominent, broadly emarginate. Mesothorax and scutellum strongly punctured, the scutellum narrowly truncate at the apex. Median segment short, obliquely truncate posteriorly, finely rugulose. Abdominal segments strongly punctured, constricted near the base, the epipygium subtriangular, very coarsely punctured. Beneath the segments are marked with a depressed transverse line near the middle, the basal portion finely, the apical strongly punctured. Entirely shining black, with sparse grey pubescence. Length 11 mm.

♀. Head subquadrate, smooth; prothorax smooth, with a very few fine punctures, rather broader posteriorly than anteriorly, longer than wide. Median segment as long as the prothorax, broadened to the apex, sparsely and finely punctured. Abdomen cylindrical, shining, very finely punctured. Epipygium rounded, with a slight depression on each side near the base, the margins slightly raised. Shining black; the prothorax, median segment, antennæ and legs ferruginous; the margins of the abdominal segments and the whole of the apical segment testaceous. Length 7 mm.

Hab.—Albany, W.A. Types in Oxford University Museum, ex Coll. Saunders.

Genus ENTELES Westw.

Enteles Westw., Arc. Ent. ii. 2, 143, 1844.

♂. Very closely resembles *Rhagigaster*, from which it may be distinguished by the broadly rounded or truncated epipygium.

The labrum is almost semicircular, truncate posteriorly, and borne on a short petiole. The labial palpi are four-jointed, the maxillary six-jointed, the joints not differing much in length. The hypopygium has no lateral spines at the base.

♀. The female has the maxillary palpi small, but six-jointed, the labial palpi four-jointed, also small. The mandibles are simple; the head is small, slightly convex. The median segment is short, obliquely truncate; the second abdominal segment is transversely carinated or striated, the number of the carinæ being about seven. The pygidium is broad, obliquely or vertically truncate and longitudinally striated.

The males and females in this group present most unexpected differences, the females closely resembling in appearance those of *Thynnoides*, and only showing a likeness to *Rhagigaster* in the structure of the palpi, though the males have always been placed in that genus without hesitation by previous authors; but Saussure places *E. morio* in a division of the genus by itself.

Type *E. hæmorrhoidalis* Guér.

Key to the Species.

♂♂. i. Abdominal segments without a close marginal band of pubescence at the base and apex.
- A. Black, the two apical segments ferruginous-red.
  - a. Prothorax rugose.
    - a^2. Mesopleuræ black. — *E. hæmorrhoidalis* Guér.
    - b^2. Mesopleuræ red. — *E. simillimus* Sm.
  - b. Prothorax transversely striated. — *E. conjugatus*, n.sp.
- B. Black, the abdomen wholly ferruginous.
  - a. Abdomen and legs bright ferruginous-red. — *E. dimidiatus* Sm.
  - b. Abdomen fusco-ferruginous, legs testaceous-yellow. — *E. testaceipes*, n.sp.
- C. Abdomen wholly black.
  - a. Mandibles strongly bidentate.
    - a^2. Wings fusco-violaceous, legs ferruginous. — *E. morio* Westw.
  - b. Mandibles almost falcate.
    - a^2. Entirely black, wings hyaline, of small size. — *E. barnardi*, n.sp.

ii. Abdominal segments with a close marginal band of pubescence at the base and apex.
- a. Prothorax with transverse striæ.
  - a^2. Entirely black. — *E. integer* Fab.

b. Prothorax rugose.

*a*². Abdomen dull ferruginous. *E. deceptor* Sm.

♀ ♀. A. Apex of the first abdominal segment with long white pubescence.

a. Thorax and median segment ferruginous-red. *E. hæmorrhoidalis* Guér.

B. First abdominal segment without pubescence.

a. Two apical abdominal segments ferruginous-red. *E. dimidiatus* Sm.

b. Black, the legs testaceous. *E. morio* Westw.

Enteles hæmorrhoidalis Guér.

Rhagigaster hæmorrhoidalis Guér., Mag. de Zool. xii. 1842(♂); *R. apicalis* Sm., Cat. Hym. B.M. vii. p.63, n.14, 1859(♂); *Thynnus ottonis* D.T., Cat. Hym. viii. 112, 1897(♂); *Enteles bicolor* Westw., Arc. Ent. ii. 2, p.143, 1844(♀); *Thynnus fimbriatus* Sm., Cat. Hym. B.M. vii. p.42, n.91, 1859(♀); *Thynnus zingerlei* D.T., Cat. Hym. viii. 119, 1897 (♀); *Thynnus lecheri* D.T., Cat. Hym. viii. 110, 1897(♂).

♂. Head rugose, a transverse undulating carina below the anterior ocellus not reaching the eyes, a V-shaped carina between the antennæ and a short longitudinal frontal carina not touching the transverse carina on the apex of the V-shaped carina. The clypeus with a carina branched very narrowly near the base, the branches not reaching the apical margin, the clypeus raised into a triangular elevation, shining and rugose, finely punctured at the base. Thorax and scutellum coarsely rugose, median segment truncate posteriorly, finely punctured-rugulose. Prothorax with the sides straight and the anterior lateral angles strongly produced. Abdomen moderately punctured, the lateral elevations on segments 2-5 near the apical margin smooth. The depressed lines at the base of the abdominal segments with a little short cinereous pubescence. Epipygium coarsely punctured, broad and very broadly rounded or subtruncate at the apex. Black, the two apical abdominal segments ferruginous-red. Wings hyaline, nervures dark fuscous.

♀. The two carinæ at the apex of the second abdominal segment are much stronger than the five or six near the base; the third segment has a few very fine and obscure short transverse striæ near the base. The apical portion of the first segment is depressed and the margin raised so as to form a carina. The median segment is short and truncate. Otherwise Westwood's description is sufficient.

Hab.—Swan River, W.A.; Victoria; Liverpool, N.S.W.

I have not seen Guérin's type, but I think I am correct in my identification, which agrees with Westwood's specimens marked *hæmorrhoidalis*.

E. CONJUGATUS, n.sp.

♂. Clypeus elevated in the centre, narrowly subtruncate anteriorly, coarsely longitudinally rugose, pointed at the base. An interantennal carina broadly rounded at the apex, and a transverse frontal carina, not reaching the eyes, connecting the extremities of the antennal carina, the space enclosed longitudinally striated; the remainder of the head finely and densely punctured, more sparsely on the occiput. Prothorax transversely striated, broadly and very slightly emarginate anteriorly, the anterior margin slightly raised, strongly produced at the lateral angles. Mesothorax coarsely rugose, scutellum very coarsely punctured; median segment short, vertically truncate posteriorly, finely and densely punctured. Abdomen shining, densely and shallowly punctured; epipygium rugulose, very broadly rounded at the apex. The abdominal segments constricted near the base; beneath very finely and densely punctured at the base, coarsely and more sparsely at the apex, the first segment with a blunt tubercle in the middle. Black, the two apical segments bright ferruginous-red. Wings fuscous with brilliant purple-blue reflections, lighter at the apex. Length 17 mm.

Hab.—Queensland.

Type in Oxford University Museum, ex Coll. Saunders.

Very near *E. hæmorrhoidalis* Guér., but the prothorax is transversely striated, and the whole sculpture finer.

E. SIMILLIMUS Sm.

Rhagigaster simillimus Sm., Trans. Ent. Soc. Lond. (3) ii. 5, p.390, 1865(♂).

Thynnus wolframii D.T., Cat. Hym. viii. 119(♂).

Probably only a local form of *E. hæmorrhoidalis*, from which it differs mainly by the red colour of the mesopleuræ, the lesser development of the frontal carinæ, and the presence of a fine median longitudinal carina on the epipygium.

♀. Unknown.

Hab.—N.W. Australia.

E. DIMIDIATUS Sm.

Rhagigaster dimidiatus Sm., Cat. Hym. vii. p.62, n.10, 1859(♂♀).

Thynnus ottenhallii D.T., Cat. Hym. viii. 112, 1897(♂♀).

♂. Clypeus coarsely longitudinally rugose. Front and vertex rugulose, an undulating transverse carina between the eyes, a wide V-shaped carina between the antennæ joining at the apex a short longitudinal carina which extends on to the basal portion of the clypeus. Prothorax transversely rugulose, the anterior margin raised and produced at the lateral angles. Mesothorax and scutellum coarsely rugose; median segment truncated posteriorly, finely rugulose at the base, finely punctured on the surface of the truncation. Epipygium rugulose at the base, longitudinally striated on the apical portion, truncate at the apex with a slight median emargination, the margin recurved.

♀. Third abdominal segment delicately transversely striated near the base. Pygidium vertically truncate posteriorly, the surface of the truncation longitudinally striated, the extreme apex smooth and narrowly rounded. Otherwise as in Smith's description.

Hab.—Sydney, N. S. W.

E. TESTACEIPES, n sp.

♂. Head punctured, very sparsely and finely on the occiput; a strong undulating transverse carina below the anterior ocellus, not quite reaching the eyes, a rounded carina between the

antennæ the ends reaching the transverse carina, the enclosed space longitudinally rugulose with a smooth line immediately below the transverse carina. Clypeus with two carinæ diverging from the base but not reaching the apex, the space between them elevated, narrow and rugulose, the sides of the clypeus punctured. Prothorax obscurely transversely rugulose. Mesothorax and scutellum coarsely and rather sparsely punctured. Median segment almost smooth, vertically truncate posteriorly, the posterior angles prominent. Abdominal segments slightly constricted at the base, sparsely punctured; the epipygium truncate at the apex, irregularly longitudinally striated. Hypopygium with the usual recurved aculeus armed with a strong blunt tooth on the upper surface. First abdominal segment beneath with a tubercle near the base. Black, the abdomen fusco-ferruginous, the legs testaceous-yellow, the coxæ black and the tarsi obscure fuscous. [Wings missing]. Length 19 mm.

Hab.—Australia.

Type in Oxford University Museum, ex Coll. Westwood.

E. INTEGER Fab.

Thynnus integer Fab., Syst. Ent. p.360, n.3, 1775(♂).
Rhagigaster integer Sm., Cat. Hym. B.M. vii. 60, 1859(♂).

Smith has published a good description of this insect. The type, which is as far as I know still unique, is in good condition in the Banksian Collection. Probably, like most of the Australian insects in that collection, it was taken at Cooktown, Q.

E. DECEPTOR Sm.

Thynnus deceptor Sm., Descr. n.sp. Hym. p.169, n.30, 1879(♂).

♂ The clypeus has a prominent Λ-shaped carina, the front is produced over the base of the antennæ, and there is a short transverse carina below the anterior ocellus. The median segment is vertically truncate posteriorly, and the abdomen is finely and densely punctured. Epipygium strongly longitudinally striated, broadly truncate at the apex with a very slight median

emargination. The aculeus is sharply recurved, but does not project much beyond the epipygium.

There is a colour variety in the British Museum in which the abdomen is dark fuscous.

The female placed with this species in the British Museum Collection probably does not belong to it.

Hab.— N.W. Australia.

Most nearly allied to *E. integer* Fab.

E. MORIO Westw.

Rhagigaster morio Westw., Arc. Ent. ii. 2, p.105, n.4, 1844(♂); Sauss., Reise d. Nov. Zool. ii. 1, p.114, n.6, t.4, f.67, 1867(♂); Sauss., Stett. Ent. Zeit. xxx. p.58, n.8, 1869(♀).

Thynnus serripes Sm., Cat. Hym. B.M. vii. p.44, n.125, 1859(♀).

Saussure's descriptions are good. He expresses some doubt as to the correctness of the pairing, which has been now settled by more than one collector.

Hab.—Sydney, N. S.W.

My dissections of the female show the maxillary palpi six-jointed as in Westwood's plate showing *E. bicolor*.

E. BARNARDI, n sp.

♂. Mandibles slender, almost falcate, the tooth on the inner margin hardly at all developed. Clypeus with a short longitudinal carina from the base, which branches in front enclosing a triangular space which is shining, and sparsely punctured, the punctures large and confluent. The sides of the clypeus covered with long white pubescence. A V-shaped carina between the antennæ and a transverse frontal carina, which does not reach the eyes. Front finely rugulose, occiput punctured. Labrum exposed. Prothorax rugulose, the lateral angles less prominent than in the other species of the genus; mesothorax and scutellum coarsely punctured. Median segment finely punctured, vertically truncate posteriorly, the surface of the truncation delicately reticulated. Abdomen densely punctured, the two apical segments most coarsely, segments 2-6 constricted near the base. No

tubercle beneath the first segment. Epipygium broadly truncate at the apex, punctured, with delicate, short, longitudinal striæ near the apex. The aculeus of the hypopygium does not extend much beyond the epipygium. Black, with greyish-white pubescence. Apical half of the mandibles and the legs piceous. Length 11 mm.

Hab.—Duaringa, Q.

The head and prothorax of a female pinned with this resemble those parts in other species of the genus.

Genus AELURUS Klug.

Aelurus Klug, Physik. Abh. Akad. Wiss. Berlin, 1840, p. 42, 1842 (nec *Aelurus* Sm.).

♂. Antennæ long and slender; head more or less narrowed behind the eyes; mandibles bidentate; labium short, labial palpi four-jointed, the first joint much the longest; maxilla small, galea subtruncate at the apex and not divided; maxillary palpi six-jointed, the apical joints filiform, very long and slender, the three basal joints short and stouter, the first extremely short. Labrum transverse, short. The division of the first cubital cell is marked by a scar only, and the third cubital cell is not much narrowed along the radial nervure.

♀. Head nearly rectangular; antennæ thick; mandibles large, not bidentate; abdomen cylindrical. Tarsal ungues simple. Ashmead gives the maxillary palpi as four-jointed.

I have not been able to dissect a female, nor does Klug give any details as to the mouth-parts. The two Australian species which I assign to this genus correspond well with the male of *Ael. clypeatus*, figured by Klug, in mouth-parts and neuration, and are very different from the Australian species assigned to *Aelurus* by Westwood and Smith (*Tachynomyia*). I have separated the genus *Lepteirone* from *Aelurus* on account of the narrowing of the third cubital cell along the radial nervure. But *Ael. nasutus* Klug, is the type of the genus, not *Ael. clypeatus*; and the neuration may possibly differ.

Type *Ael. nasutus* Klug (Brazil).

Key to the species of Aelurus.

♂♂. A. Scutellum broadly rounded at the apex.

a. Black, legs and antennæ ferruginous. *Ael. grandiceps*, n.sp.

B. Scutellum subtriangular.

b. Legs and four basal abdominal segments bright rufo-testaceous. *Ael. ruficrus*, n.sp.

AEL. GRANDICEPS, n.sp.

♂. Clypeus with a carina from the base almost reaching the apex, smooth at the apex, finely rugulose on the sides. Head very large, produced behind the eyes, shallowly but strongly punctured; a V-shaped carina between the antennæ. Prothorax very sparsely and shallowly punctured, the anterior margin raised. Mesothorax sparsely punctured on the disc, densely and finely on the sides. Scutellum rounded posteriorly. Median segment short, reticulate, almost smooth at the base, obliquely truncate. A short sulca from the base of the first abdominal segment, and a minute tubercle at the base beneath; a transverse impressed line near the base of segments 2-5. Epipygium truncate at the apex, hypopygium rounded and ciliated. Abdomen shining, shallowly and sparsely punctured. Black, with a little fulvous pubescence; mandibles, except the apex, antennæ and legs, fulvous. Wings fulvo-hyaline, nervures fulvous. Length 15 mm.

♀. Head rectangular, the posterior angles slightly rounded, much longer than broad, strongly punctured, the punctures large and elongate; front produced into a very small blunt tubercle on each side at the base of the antenna. Clypeus with a median carina. Thorax and median segment with deep, elongate punctures, often confluent. Prothorax subquadrate, slightly narrowed anteriorly; median segment longer than the prothorax, very little broadened posteriorly, obliquely truncate. Abdomen cylindrical, punctured, the punctures shallower than those on the thorax, but more elongate and confluent. Pygidium simple, rounded at the apex. Castaneous-brown, the abdomen darker. Length 10 mm.

Hab.—Sydney, N.S.W.

AEL. RUFICRUS, n.sp.

♂. Clypeus with a very short carina at the base, branching broadly and shortly; the apical portion smooth and shining, not much produced at the apex, the apical margin slightly emarginate at the sides before the angles, which are produced into short, blunt spines. Head densely punctured, with an interantennal carina, rounded at the apex; slightly narrowed behind the eyes. Prothorax depressed, the anterior margin raised, very closely and minutely punctured. Mesothorax and scutellum punctured, the scutellum rather long, narrowly truncate at the apex. Median segment delicately reticulate, almost smooth at the base, rounded. Abdomen elongate, subcylindrical, shining, with shallow, scattered punctures; segments 2-5 with a transverse line near the base. Epipygium strongly punctured, smooth at the apex and subtruncate. Hypopygium rounded and ciliated. Black; with fulvous pubescence on the sides of the head and median segment; the mandibles, the apical portion of the clypeus, the legs, the tegulæ, and the four basal segments of the abdomen bright rufo-testaceous. Wings pale flavo-hyaline, nervures black, testaceous at the base. Length 15-17 mm.

Hab.—Kenthurst, N.S.W. Type in Coll. Froggatt.

Subgenus LEPTEIRONE, n.subgen.

♂. Differs from *Aelurus* in the neuration, the third cubital cell being much narrowed along the radial nervure. The clypeus has either a carina from the base ending in a tubercle before the apex, or an elevated triangular area from the base, suddenly ceasing before the apex, leaving the apex depressed below the basal portion.

The female resembles that of *Eirone* and *Aelurus* in form, but I have been unable to dissect specimens.

The insects are slenderer than in *Eirone* (♂), in this point resembling the typical S. American Aeluri.

Type *L. rufopictus* Sm.

This group occurs also in S. America, *Thynnus nigrofasciatus* Sm., belonging to it.

I do not regard the group as sufficiently distinct to merit ful generic rank.

Key to the Species of Lepteirone.

♂♂. i. Head large, produced behind the eyes, not appreciably narrowed posteriorly.

A. Abdomen light ferruginous. An interrupted yellow line on the vertex.

a. Black, clypeus and anterior margin of the prothorax yellow. *L. arenaria*, n.sp

ii. Head not produced behind the eyes, more or less narrowed posteriorly.

A. Abdomen light ferruginous.

a. Prothorax yellow.

a^2. A spot on the mesothorax and the scutellum yellow. *L. rufopicta* Sm

b^2. Mesothorax and scutellum black entirely. *L. caroli*, n.sp

b. Margins of the prothorax yellow.

a^2. An interrupted line on the vertex and the postscutellum yellow. *L. subacta*, n.sp

c. Anterior margin of the prothorax only yellow. *L. ichneumoniformis* Sm

B. Abdomen with the basal segments ferruginous.

a. Three basal abdominal segments ferruginous. *L. comes*, n.sp

b. Four basal segments ferruginous, except the base of the first. *L. pseudosedula*, n.s

C. Abdomen black.

a. Legs and antennæ ferruginous. *L. fallax* Sm

b. Basal half of flagellum of antennæ, femora and tibiæ ferruginous. *L. cubitalis*, n.s

c. Wholly black.

a^2. Slender, finely and rather sparsely punctured. *L. opaca*, n.s

b^2. More robust, more closely and strongly punctured. *L. tristis* Sm

♀♀. A. Head nearly square.

a. Median segment considerably broadened from the base.

a^2. Without a depression near the posterior angle of the prothorax. *L. ichneumoniformis* Sm

b^2. With a slight depression on each side near the angles of the prothorax. *L. cubitalis*, n.s

b. Median segment very slightly broadened from the base. *L. fallax* Sm

B. Head much longer than broad.

a. Median segment with a delicate median carina. *L. subacta*, n.s

L. RUFOPICTA Sm.

Thynnus rufopictus Sm., Descr. n.Sp. Hym. p.159, n.3, 1879(♂).

The basal portion of the clypeus is raised and narrowly triangular, the apical portion is abruptly depressed and transversely truncate at the apex. The head is produced behind the eyes, strongly rounded at the posterior angles, broader than the prothorax. Head and thorax very finely and closely punctured, median segment and abdomen almost smooth, the abdomen elongate fusiform. The scutellum is broadly rounded at the apex. The epipygium is elongate, punctured, narrowly truncate at the apex, the hypopygium narrow and ciliated at the apex.

♀. Unknown.

Hab.—Adelaide, S.A.; Melbourne.

A variety of this species in Coll. Froggatt has the median segment black instead of ferruginous, and is a rather more robust insect, the thorax being broader.

L. PSEUDOSEDULA, n.sp.

♂. Clypeus slightly produced, depressed at the extreme apex; head very closely and finely punctured, not much narrowed to the posterior margin, about as wide as the prothorax. Thorax finely and closely punctured, the anterior margin of the pronotum slightly raised. Scutellum narrowly truncate at the apex, median segment very delicately reticulate. Abdomen elongate fusiform, almost smooth; the two apical segments delicately punctured and pubescent, the apical margins of segments 1-4 slightly depressed, and a faint, depressed, transverse line near the base of segments 2-5. Black; the anterior margin of the clypeus, the inner margin of the eyes, an obscure mark on each side of the vertex, the legs, except the coxæ and the base of the trochanters, the apical half of the first and the whole of the second, third and fourth abdominal segments ferruginous; the mandibles, the anterior margin of the pronotum and a broad band on the posterior margin, and the tegulæ, yellow. Wings hyaline, iridescent; nervures testaceous-brown. Length 10 mm.

Hab.—Adelaide, S.A.

Type in B.M., ex Coll. Smith.

L. ICHNEUMONIFORMIS Sm.

Thynnus (*Agriomya*) *ichneumoniformis* Sm., Cat. Hym. B.M. vi p.39, n.102, 1859(♂).

♂. Clypeus pubescent; a carina from the base to the centr where it is slightly prominent, overlapping a smooth, obliqu triangular truncation which extends to the apex. Head fine punctured, narrowed behind the eyes. Prothorax shining, ve faintly punctured, the anterior margin raised; mesothorax a scutellum finely punctured, the scutellum large and broad rounded at the apex. Median segment delicately reticula smooth at the base, with a short longitudinal sulca from the ba Abdomen slender fusiform, with very shallow scattered punctur the epipygium strongly punctured, with sparse fulvous pubescen Black; the abdomen, except the base of the first segment, a the legs, except the coxæ and trochanters, light ferruginous; t mandibles, two small spots between the antennæ, a narrow interrupted line on the anterior margin of the prothorax, and short line before the tegulæ, yellowish-white; the mandibles the apex ferruginous. Wings hyaline, slightly iridesce nervures fuscous, tegulæ testaceous. Length 9 mm.

♀. Head rectangular, a little longer than broad, smooth a shining, with a delicate, median, frontal sulca. Thorax a median segment sparsely punctured, the median segment elonga longer than the prothorax, broadened from the base, and oblique truncate at the apex. Abdomen subcylindrical, shining, wi large, elongate punctures; the epipygium with a broad, medi longitudinal carina, narrowly rounded at the apex; the first se ment beneath with a minute tubercle at the base. Ferrugino brown, the abdominal segments stained with black on the sid Length 5 mm.

Hab.—Berwick, Melbourne, Vic.

The type appears to be lost, and my identification may possib be mistaken.

L. CAROLI, n.sp.

♂. Clypeus with a short carina from the base, which en about the centre in a subtubercular prominence, overlapping

broad triangular truncation extending to the apex. Head very finely and densely punctured, a short, median frontal sulca between the antennæ, separating two small tubercles. Prothorax shining, with very minute, shallow punctures, the anterior margin slightly raised. Mesothorax and scutellum densely and finely punctured, the scutellum subtriangular, rounded at the apex. Median segment very finely reticulate, with a short, median, longitudinal sulca from the base. Abdomen elongate fusiform, very faintly punctured, shining; epipygium strongly punctured, with thin fulvous pubescence on the sides. Hypopygium rounded and ciliated at the apex. Black; the antennæ, legs, except the coxæ, and abdomen, light ferruginous; the mandibles, the triangular truncation of the clypeus and the anterior margin at the sides of the clypeus, the prothorax, except a black spot in the middle and the tegulæ, yellow. Wings hyaline, iridescent, nervures fuscous. Length 10 mm.

Hab.—Victoria (French).

L. ARENARIA, n.sp.

♂. Head large, produced behind the eyes, the sides nearly parallel; shining, rather closely and shallowly punctured; two rather prominent tubercles between the antennæ. The clypeus with a small elevated triangular area on the basal portion, depressed on the apical portion, subtruncate at the apex and produced into minute spines at the apical angles. Prothorax almost smooth with minute shallow punctures. Mesothorax and scutellum shining, rather sparsely punctured, scutellum broadly rounded at the apex. Median segment nearly smooth at the base, very finely transversely rugulose at the apex. Abdomen shining, with a few scattered punctures; epipygium punctured, elongate, with a very fine median carina at the apex, and with sparse fulvous pubescence. Black; the abdomen, except the extreme base, and legs, except the coxæ and trochanters, ferruginous. A fuscous mark on the fifth abdominal segment. The anterior margins of the clypeus and face uniting with a central mark on the clypeus extending nearly to the base, the two

tubercles between the antennæ, a broadly interrupted line on the vertex, a narrowly interrupted line on the anterior of the prothorax and a narrow line in front of the tegulæ, yellow. The wings hyaline, tegulæ and nervures at the base dark testaceous, the nervures at the apex black. Length 11 mm.

♀. Unknown.

Hab.—Victoria (French).

L. SUBACTA, n sp.

♂. Head not much narrowed behind the eyes nor produced; closely and finely punctured, with two slightly prominent tubercles between the antennæ. The clypeus is depressed along the apical margin, with a slight tubercle on each side before the apex. Prothorax almost smooth, the anterior margin considerably raised; mesothorax and scutellum closely and finely punctured, the scutellum subtruncate at the apex. Median segment very finely reticulate, with a very small, transverse, shining mark at the base, rounded at the apex. Abdomen shining, with a few scattered punctures. Epipygium with a broad median carina, not elongate, narrowly rounded at the apex, thinly clothed with long fulvous hairs. Black; the legs, except the coxæ and trochanters, the abdomen, except the extreme base, and a spot at the apex of the scutellum, ferruginous; the margin of the face and clypeus, a triangular spot on the clypeus, the tubercles between the antennæ, an interrupted line on the vertex, the anterior margin of the prothorax narrowly and the posterior margin broadly, almost uniting with the anterior marginal line in the middle, and the postscutellum, yellow. Wings hyaline, nervures dark fuscous. Length 9 mm.

♀. Head rectangular, nearly twice as long as broad, shining, sparsely punctured, with a slight median frontal sulca. Thorax sparsely punctured; prothorax shorter than the median segment, narrowed and rounded anteriorly. Median segment elongate, the sides almost parallel. Abdomen cylindrical, finely punctured; a median longitudinal depression on the apical portion of segments

2-4. Epipygium with a median carina. Castaneous-brown. Length 5 mm.

Hab.—Adelaide (Fortnum). Types in Oxford University Museum.

L. COMES, n.sp.

♂. Very slender. Clypeus with a raised triangular elevation from the base to near the apex, where it is broadest, suddenly depressed at the apex. Head densely and finely punctured, narrowed posteriorly. Prothorax shining, almost smooth; mesothorax delicately punctured, scutellum rather long, narrowly rounded at the apex. Median segment delicately reticulate, with a deep longitudinal sulca from the base reaching about half-way to the apex. Abdomen with a few shallow punctures, the apical segment more coarsely punctured, with thin fulvous pubescence. Black; the mandibles yellow, ferruginous at the apex; the antennæ, legs, except the coxæ and trochanters, the two basal abdominal segments and the third at the base, dark ferruginous the two apical joints of the antennæ fuscous. A very narrow interrupted white line on the anterior margin of the prothorax. Wings hyaline, iridescent, nervures fuscous. Length 7 mm.

Hab.—Victoria (French).

L. OPACA, n.sp.

♂. Slender. Clypeus with a basal carina produced into a prominent tubercle in the centre of the clypeus; head finely punctured, with a short white pubescence and a very fine median frontal sulca; narrowed behind the eyes. Prothorax rather depressed, narrowed anteriorly, very finely and shallowly punctured; mesothorax more strongly punctured; scutellum subtriangular, narrowly rounded at the apex; median segment reticulate, almost smooth at the base, with white pubescence on the sides. Abdomen slender, shining, with very minute, shallow punctures, a slightly raised mark on each side of segments 2-5 near the apical margin. Epipygium strongly punctured, broadly rounded at the apex. Entirely black, the head opaque, thorax and

abdomen shining. Wings hyaline, iridescent, nervures black. Length 10 mm.

The third cubital cell subtriangular, being very short along the radial nervure.

Hab.—Victoria (French).

L. TRISTIS Sm.

Thynnus (*Agriomyia*) *tristis* Sm., Cat. Hym. B.M. vii. p.34, n.88.

♂. Head densely punctured; the clypeus with a longitudinal carina from the base to the centre, where it is produced into a tubercle. The anterior margin of the prothorax raised, the scutellum transversely truncate at the apex; the whole thorax closely punctured, most finely on the prothorax. Median segment finely reticulate, almost smooth at the base. Abdomen finely and closely punctured, the epipygium rugulose. Entirely black. Wings hyaline, iridescent, nervures dark fuscous. Length 12 mm.

The antennæ are shorter and stouter than in most species of the genus.

Hab.—Australia.

L. FALLAX Sm.

Thynnus fallax Sm., Cat. Hym. B.M. vii. p.35, n.91, 1859(♂).

A pair from Adelaide in the Hope Collection at Oxford.

The male differs from the type in having the space at the base of the median segment punctured instead of smooth and shining. The scutellum is rather narrowly truncate at the apex.

♀. Head rectangular, rather longer than broad, very sparsely and finely punctured, shining. Thorax and median segment shining, sparsely and finely punctured; the prothorax almost square; the median segment longer than the prothorax, the sides almost parallel, obliquely truncate posteriorly. Abdomen shining, more densely punctured than the thorax, the first segment vertically truncate anteriorly, and with a small acute tubercle at the base beneath. Epipygium narrowly rounded at the apex, with a slightly raised, broad median carina. The abdomen is

subcylindrical. Ferruginous-brown; the abdomen fuscous, except the apical segment. Length 9 mm.

Hab.—Adelaide.

The male closely resembles *Eirone ruficornis* Sm., in general appearance.

L CUBITALIS, n.sp.

♂. Clypeus slightly advanced, truncate at the apex, a median carina from the base ending in a minute tubercle a little before the apex, very finely punctured. Head densely punctured, narrowed behind the eyes, with two small tubercles between the antennæ. Prothorax shining, very finely punctured, the anterior margin raised, with a faint, depressed, shining line behind the margin. Mesothorax punctured, the scutellum subtriangular, narrowly rounded at the apex. Median segment delicately reticulate, slender. Abdomen subpetiolate fusiform, shining, with minute shallow punctures and long cinereous pubescence on the sides of the apical segments. Black; the antennæ from the third to the eighth joints, the mandibles at the apex, the tibiæ, tarsi, and posterior femora ferruginous; the mandibles at the base, a narrow line on the anterior margin of the clypeus, a narrow, interrupted line on the anterior margin of the prothorax and a narrow transverse line on the postscutellum, creamy-white. Wings hyaline, slightly iridescent, nervures dark fuscous. Length 7 mm.

♀. Head rectangular, longer than wide, slightly rounded at the posterior angles, shining, with a few minute punctures, a very short median frontal sulca, front between the antennæ deeply emarginate. Thorax and median segment with sparse, large, elongate punctures, prothorax rectangular, longer than broad, rather narrower than the head; median segment longer than the prothorax, moderately broadened to the apex. Abdomen cylindrical, more closely punctured than the thorax, the apical portion of the epipygium smooth with a longitudinal median carina. First abdominal segment beneath with a minute tubercle at the

base. Chestnut-brown, stained with black on the median segment and on the abdominal segments above. Length 4 mm.

Hab.—Victoria (French). Types in Coll. Froggatt.

Subgenus Eirone Westw.

Eirone Westw., Arc. Ent. ii. 2, 144, 1844.

♂. Very near *Aelurus* Klug, from which it differs in the joints of the maxillary palpi, the three apical joints in *Eirone* being only a little more than half as long again as the three basal joints.

♀. Head rectangular; maxillæ small, with four-jointed maxillary palpi; labial palpi four-jointed. Abdomen cylindrical or sub-cylindrical. Tarsal ungues simple.

In *E. dispar*, the typical species, the mandibles of the female are bidentate, but this is not usually the case.

The differences between this and *Aelurus* are, in my opinion, too slight to merit full generic rank. Ashmead (Canad. Ent. xxxv.) mentions *Eirone* among genera of which the female only is known, and suggests that *Lophocheilus* Guér., may be the male. He cannot have looked at Westwood's description and figures, which are very good and clear; but has probably been misled by an error of Saussure's.

Type *E. dispar* Westw.

Key to the Species of Eirone.

♂♂. i. Clypeus with a triangular truncation at the apex.
- A. Head very large, produced behind the eyes.
  - *a*. Median segment short, truncate.
    - a^2. Anterior margin of prothorax yellow, legs testaceous. Length 6-8 mm. — *E. crassiceps*, n.sp.
- B. Head not so large.
    - a^2. Antennæ and legs yellow. Length 10 mm. — *E. lucidula*, n.sp.
    - b^2. Legs only yellow. Length 10 mm. — *E. lucida* Sm.
    - c^2. Antennæ, legs, prothorax and scutellum yellow. Length 5-7 mm. — *E. scutellata*, n.sp.
  - *b*. Median segment rounded.
    - a^2. Legs and antennæ ferruginous. Length 11 mm. — *E. ruficornis* Sm.
    - b^2. Antennæ only ferruginous. Length 7 mm. — *E. fulvicostalis*, n.sp.

c^2. The triangular truncation of the clypeus white.
a^3. A white line on the anterior margin of the prothorax.
a^4. Clypeus without a median carina; with a minute tubercle on each side. *E. tuberculata* Sm.
b^4. Clypeus with a median carina. *E. vitripennis* Sm.
b^3. Prothorax wholly black. Length 8 mm. *E. osculans*, n.sp.
ii. Clypeus without a triangular truncation at the apex.
A. Abdominal segments slightly constricted near the base.
a. Wholly black.
a^2. Thorax strongly punctured.
a^3. Median segment with a broad low median carina at the base. *E. tenuipalpa*, n.sp.
b^3. Median segment without a carina. Length 11 mm. *E. dispar* Westw.
b^2. Thorax finely punctured. Length 6 mm. *E. tenebrosa*, n.sp.
b. Postscutellum white.
a^2. Clypeus white, antennæ black. Length 5 mm. *E. parca*, n.sp.
b^2. Clypeus black, antennæ fuscous. *E. inconspicua*, n.sp.
B. Abdominal segments not constricted.
a. Clypeus with a median carina from base to apex.
a^2. Head and five basal segments of abdomen ferruginous. Length 13 mm. *E. ferrugineiceps*, n.sp.
b^2. Light castaneous, two apical segments of abdomen black. Length 12 mm. *E. castaneiceps*, n.sp.

♀♀. i. Abdomen subcylindrical.
a. Black, prothorax and two basal segments of the abdomen ferruginous. *E. lucidula*, n.sp.
b. Wholly castaneous.
a^2. First abdominal segment truncate, with a minute spine at each angle. *E. scutellata*, n.sp.
b^2. Pygidium with minute lateral spines and a tuft of hair at the apex. *E. fulvicostalis*, n.sp.
ii. Abdomen cylindrical.
A. Median segment longer than the prothorax.
a. With an impressed median longitudinal mark on the apical half of abdominal segments 2-4.
a^2. First abdominal segment short, much broadened from the base. *E. tuberculata* Sm.
b^2. First abdominal segment not short, not much broadened from the base. *E. tenebrosa*, n.sp.
b. Without an impressed longitudinal mark on segments 2-4.
a^2. Delicately punctured, mandibles bidentate. *E. dispar* Westw.

b^2. Strongly punctured, mandibles simple. *E. tenuipalpa*, n.sp.

B. Median segment about the same length as the prothorax.

***a.* Front between the antennæ deeply emarginate. *E. parva*, n.sp.**

E. DISPAR Westw.

Eirone dispar Westw., Arc.Ent.ii.2,p.144,t.82,f.5-6,1844 (♂♀).

? *Thynnus* (*Agriomyia*) *brevicornis* Sm., Cat. Hym. B. M. vii. p.39, n.103, 1859(♂).

The female of this species has the mandibles bidentate. In other nearly related species the mandibles are simple. Westwood gives full details as to the mouth-parts in his plates and in his generic description. *Thynnus brevicornis* Sm., is almost certainly a synonym, but the type seems to be lost and the description is not sufficiently full for absolute certainty.

Hab.—Adelaide, S.A.

E. TENUIPALPA, n.sp.

♂. Head transverse, slightly narrowed posteriorly; clypeus densely and finely punctured, smooth on the apical margin, not much advanced. Head and thorax strongly punctured; prothorax very long, the anterior margin slightly elevated at the sides, slightly emarginate in the middle. Median segment with a fine median carina from the base to the centre, a smooth area at the base, the remainder finely transversely rugulose, smooth at the extreme apex. Abdomen fusiform, the first segment with a median longitudinal sulca not reaching the apex, subtuberculate beneath at the base. Segments 2-4 with an impressed transverse line near the base, and slight lateral elevations near the apical margin. All the segments densely punctured, almost smooth at the base. Hypopygium rounded, ciliated at the apex. Black, the abdomen shining, mandibles fusco-ferruginous. Wings hyaline, faintly iridescent, a fuscous cloud in the radial and second cubital cells, nervures black. Length 12 mm.

♀. Head rectangular, slightly rounded at the posterior angles, longer than broad, with a faint median frontal sulca. Head, thorax and median segment punctured, the punctures large and

othorax slightly narrowed anteriorly; median seg-
than the prothorax, moderately broadened to the
is obliquely depressed. First abdominal segment
ncate anteriorly ; the surface of the truncation
a median sulca. The four basal segments with
ctures, shallow on the fourth segment. Apical
finely punctured, the punctures not elongate.
th a delicate, longitudinal median carina. A
cle at the base of the first segment beneath.
indrical. The mandibles are not bidentate.
neous-brown. Length 7 mm.

kay, Q.

par Westw., from which it differs in the sculpture
segment in the male, and the simple mandibles of

E. TENEBROSA, n.sp.

and head delicately and closely punctured; clypeus
rina. Prothorax shining, with very fine, almost
unctures, the anterior margin raised. Mesothorax
more strongly punctured, the scutellum narrowly
e apex; median segment rather short, delicately
a smooth mark at the base. Abdominal segments
ed, smooth at the extreme apex; a raised mark
ical margin and strongly emarginate posteriorly in
segments 2-4. Entirely black, the mandibles
ngs hyaline, strongly iridescent, nervures fuscous.

ctangular, longer than broad, shining, with a few
punctures; a very fine sulca between the antennæ.
edian segment shining, with scattered punctures,
narrower than the head; the median segment
he prothorax, very slightly widened to the apex.
ndrical, rather sparsely punctured, the punctures
gate, a depressed, median, longitudinal line on the
segments 2-4. Epipygium with a delicate median

carina, not reaching the apex, which is pointed. Shining castaneous-brown, abdominal segments 2-5 stained with black. Length 6 mm.

Hab.—Melbourne (Bakewell).

Types in Oxford University Museum.

E. INCONSPICUA, n.sp.

♂. Clypeus short, without a triangular truncation at the apex head delicately punctured, with a short, faint sulca between the antennæ. Anterior margin of the prothorax moderately raised the whole thorax punctured. The median segment finely reticulate Abdomen finely punctured, the median sulca on the first segment extending from the base more than half-way to the apex, segments 2-4 with an impressed transverse line near the base, and with a raised mark on each side near the apical margin, the marks indistinctly connected and widely emarginate in the centre Shining black, with white pubescence; the postscutellum white the mandibles, antennæ and the tarsi of the anterior legs fusco ferruginous. Wings hyaline, iridescent, nervures black. Length 6 mm.

♀. Unknown.

Hab.—Cairns, Q.

Allied to *E. parca.*

E. PARCA, n.sp.

♂. Clypeus hardly at all advanced, without a basal carina or oblique truncation, transversely truncate at the apex, very delicately punctured, pubescent at the sides. Head finely punctured, with a very delicate longitudinal carina from the vertex to the anterior ocellus. Prothorax long, the anterior margin raised except in the middle, very finely and closely punctured, as is also the mesothorax, which is very short. Scutellum subtriangular narrowly truncate at the apex, rather more sparsely punctured Median segment finely reticulate, almost smooth at the base Abdomen fusiform, very delicately and closely punctured, the first segment with a short sulca from the base; segments 2-4 with a raised mark on each side near the apical margin, and with the

widely emarginate. Hypopygium rounded and
apex. Black; the clypeus, postscutellum and an
e on the anterior margin of the prothorax white;
anterior tibiæ and tarsi fuscous. Wings hyaline
a fuscous cloud in the radial cell, nervures fusco-
ength 7-8 mm.

tangular, rather longer than broad, the front
ntennæ deeply and narrowly emarginate; the
e at the apex, not bidentate. The whole insect
punctures large and elongate. The prothorax
oad, slightly narrowed anteriorly; the median seg-
same length as the prothorax, slightly narrowed
median segment about the same length as the
htly broadened to the apex, obliquely depressed
Abdomen cylindrical, the first segment vertically
base. Entirely castaneous. Length 5 mm.
ay, Q.(♂♀ in cop.).

E. FULVICOSTALIS, n.sp.

lightly advanced, punctured, with a small, sub-
cation at the apex, the apical margin transversely
d and thorax densely and finely punctured, the
very long, with the anterior margin raised and
parallel; the scutellum rounded at the apex, the
t reticulate, closely punctured at the base, short
Abdomen short, fusiform, finely punctured; the
ith a short median sulca from the base; segments
d mark on each side near the apical margin. The
unded and ciliated at the apex. Black; the
antennæ, except the scape, fulvous; the tibiæ and
erior legs fuscous. Wings hyaline, faintly flavo-
e base, splendidly iridescent, nervures fulvous.

e insect punctured, the punctures large and more
e. Head rectangular, longer than wide, with a
frontal sulca; wider than the thorax. Prothorax

slightly narrowed anteriorly, broader than long; median segm much broadened at the apex, where it is obliquely trunc Abdomen subcylindrical, first segment vertically truncate a riorly, the two apical segments narrowed, the pygidium poin with a small tuft of pubescence at the apex. Chestnut-bro abdominal segments suffused with fuscous. Length 3-4 mm.

Hab.—Mackay, Q (♂♀ in cop.).

E. osculans, n.sp.

♂. Clypeus very slightly advanced, with a very short ca from the base joining a narrow, oblique, triangular truncat which extends to the apex. Head densely punctured, narro behind the eyes. Prothorax long, the anterior margin strai and raised, the raised collar narrowly interrupted in the mid Mesothorax and prothorax very delicately punctured, the thorax most sparsely; scutellum sparsely punctured, rounded the apex. Median segment finely reticulated, smooth at the b Abdomen very delicately and closely punctured, shining, elong fusiform, the first segment with a short median basal sulca, ments 2-4 with slightly raised marks on each side near the ap margin. Hypopygium rounded, ciliated. Black; a white on the anterior margin of the clypeus, the triangular truncat of the clypeus white; tibiæ and tarsi of the anterior legs fusc Wings hyaline, with a faint fuscous cloud in the radial nervures fuscous. Length 8 mm.

Hab.—Mackay, Q.

Nearest to *E. vitripennis* Sm.

E. vitripennis Sm.

Thynnus (*Eirone*) *vitripennis* Sm., Cat. Hym. B. M. vii. p n.113, 1859(♂♀).

♂. The scutellum is rounded at the apex; the median segm is rounded, depressed at the apex, delicately reticulate, n finely at the base. The abdomen is finely and very shallo punctured. The third cubital cell is considerably narro along the radial nervure.

a (Lower Plenty).
der this name in the British Museum does not
Smith's description.
ars to be lost.

E. TUBERCULATA Sm.

ne) tuberculatus Sm., Cat. Hym. B. M. vii. p.41,

um is rather broadly subtruncate at the apex;
ent rather long and narrow at the apex, finely
short median sulca from the base. The abdomen
egments 2-4 with a curved raised mark near the
each side.
d median longitudinal line on the apical portions
gments 2-4, and a curved raised mark on each
cal margin. The pygidium at the apex is acute,
ian carina and the lateral margins slightly raised.
a (Lower Plenty).

E. RUFICORNIS Sm.

iomyia) ruficornis Sm., Cat. Hym. B.M. vii. p.34,

ltii D.T., Cat. Hym. viii. 108(♂).
as a short carina from the base, joining a smooth,
ar truncation which extends to the apex. Hypo-
and ciliated at the apex.
River, W.A.

E. SCUTELLATA, n.sp.

th a very short delicate carina from the base, a
triangular truncation at the apex. Head and
punctured; head narrowed behind the eyes; the
of the prothorax very slightly raised; the scu-
roadly truncate at the apex. Median segment
and subtruncate posteriorly, delicately reticulate.
ments shining, with very fine punctures at the

base, smooth at the apex. Pygidium smooth and round Abdomen fusiform, short. Black; antennæ fuscous, the sc ferruginous; mandibles, the anterior portion of the clypeus narrowly interrupted line on the anterior margin of the prothor a curved line before the tegulæ, the tegulæ, a large spot on scutellum, a transverse line on the postscutellum and the l yellow. Wings hyaline, iridescent, nervures testaceous. Len 5-7 mm.

♀. Head much longer than wide, slightly narrowed to posterior margin, shining, very finely and sparsely punctu with a very delicate median frontal sulca. Prothorax narro and rounded anteriorly, about the same length as the med segment, which is moderately broadened to the apex where i obliquely truncate. Thorax, median segment and abdo shining, with large, elongate, shallow punctures. Abdomen s cylindrical, the first segment truncate at the base, the lat angles of the truncation produced into short spines, a min tubercle beneath near the base. Epipygium pointed. Enti castaneous. Length 3 mm.

Hab.—Mackay, Q.(♂♀ in cop.), Cape York, Q.

Cape York specimens have the whole pronotum yellow, the sculpture on the median segment is coarser.

E. LUCIDA Sm.

Thynnus (*Agriomyia*) *lucidus* Sm., Cat. Hym. B.M. vii. p. n.95, 1859(♂).

The antennæ are black, not yellow as in the following spec it is also much less strongly punctured, especially on the abdom The type is in the Oxford University Museum.

♀. Unknown.

Hab.—Tasmania.

E. LUCIDULA, n.sp.

♂. Clypeus almost smooth, a very faint median carina fr the base to the centre, whence the clypeus is broadly triangula truncate to the apex. Head punctured, least strongly on occiput. Prothorax of moderate length, the anterior mar

hole thorax punctured, the scutellum rounded at
lian segment smooth at the extreme base, with a
epression, the remainder of the segment rugulose,
r the apex; the segment is obliquely depressed to
domen short, fusiform, delicately punctured; the
ith a short median sulca from the base. Hypo-
r rounded, ciliated. Black; antennæ, mandibles,
apical half, tegulæ and legs yellow. Wings
y iridescent, nervures fuscous, testaceous at the
10-11 mm.

tangular, rather longer than broad, with fine
ures, the front more closely punctured, with a
ontal sulca. Thorax and median segment sparsely
ictured; the prothorax narrowed and rounded
road on the posterior margin as long; the median
as the prothorax, obliquely truncate at the apex,
arly twice as broad as at the base. Abdomen
he thorax, subcylindrical, punctured. Pygidium
ointed at the apex. Black; the antennæ fusco-
prothorax, the two basal and two apical abdominal
nandibles, clypeus, anterior legs, all the tarsi and
ex of the intermediate and posterior tibiæ ferru-
ngth 5 mm.

ay, Q.(♂♀ in cop.); Wagga, N.S.W.; Victoria;

rom S. Australia has the legs entirely ferruginous
nd fourth abdominal segments black on the basal

E. CRASSICEPS, n.sp.

ot much produced, with a short carina from the
ique triangular truncation at the apex, the surface
on smooth, the sides very finely punctured. Head
ery slightly narrowed behind the eyes, densely
nall V-shaped carina between the antennæ, the
he carinæ marked with a very faint median carina.
y punctured, the anterior margin raised, as broad

as the head but not long. Mesothorax and scutellum strong punctured, the scutellum strongly rounded at the apex. Medi segment strongly punctured, reticulate at the apex and smoo at the extreme base, obliquely truncate posteriorly. Abdom densely covered with minute shallow punctures; first segme with a short median sulca from the base and a small tubercle the base beneath; segments 2-4 with a small, raised, smooth ma on each side near the apical margin. Epipygium smooth, round at the apex. Black; the antennæ fusco-ferruginous; legs pa ferruginous marked with yellow; clypeus, mandibles, a line the anterior margin of the prothorax and the tegulæ yello Wings hyaline, slightly iridescent, nervures black. Leng 6-8 mm.

♀. Unknown.

Hab.—Cape York, Q.

E. FERRUGINEICEPS, n.sp.

♂. Head rather large, strongly punctured; clypeus produc moderately, transversely rugose, with a median carina from t base to the apex. Prothorax long, as broad as the head, trar versely rugulose, the anterior margin raised, the sides not qui parallel. Mesothorax and scutellum strongly punctured, t scutellum subtriangular, narrowly rounded at the apex. Medi segment short, depressed to the apex, finely reticulate, smooth the base. Abdomen punctured, with a transverse line near t base of segments 2-4, which are almost smooth at the base a on the apical margin. Epipygium at the apex smooth a rounded. Black; head, except the clypeus and mandibles, t five basal abdominal segments, except the base of the fir ferruginous. Tarsi fuscous. Wings hyaline, nervures blac Length 11-13 mm.

The first abdominal segment has an acute tubercle near t centre beneath.

♀. Unknown.

Hab.—Sydney.

Apparently allied to *E. castaneiceps*, but I have not been ab to study the mouth-parts.

E. CASTANEICEPS, n.sp.

♂. Clypeus produced anteriorly, rather narrowly truncate at the apex, with a longitudinal carina from the base to the apex, punctured. Head rather large, strongly punctured, the antennæ very short, a raised carina above the base of the antennæ on each side, the front between the antennæ narrowly truncate. Prothorax long and broad, as broad as the head, the sides parallel, the anterior margin raised. The thorax finely and densely punctured, most finely on the prothorax; the scutellum triangular, more sparsely punctured, with a very delicate longitudinal carina from the base to the apex. Median segment smooth at the base, very finely reticulate on the apical portion, rather short and obliquely depressed to the apex. Abdomen shining, with close, shallow punctures, the apical margins of the segments smooth. Segments 2-4 with a faint depressed transverse line near the base and a faint raised mark on each side near the apical margin. Pygidium smooth and rounded at the apex. The first segment beneath with an elevated longitudinal carina from the base, ending in a tubercle at the base of the oblique, triangular, apical truncation of the segment. Light chestnut-brown; the clypeus, anterior margin of the prothorax and postscutellum yellowish; antennæ, except the scape, and the three apical abdominal segments black. Wings hyaline, faintly iridescent, nervures fuscous, stigma testaceous. Length 12 mm.

♀. Unknown.

Hab.—Mackay, Q.

The first and third joints of the maxillary palpi are the shortest, the others subequal. May have to be separated from *Eirone*.

Genus ARIPHRON Erichson.

Ariphron Erichs., Arch. f. Naturgesch. viii. Pt. 1, p. 264, 1842(♀).

♂. Clypeus very narrowly produced, usually with a median carina; antennæ of moderate length, usually longer than the head and thorax without the median segment. Head rounded, the sides with rather long pubescence, not much lengthened and

curled as in *Tachynomyia*. The head beneath concave, but no nearly as widely so as in *Tachynomyia*. Maxillary palpi wit the three apical joints filiform and much elongated as in *Aeluru* the basal joint very short. Labium rather short, labial pal rather stout, the basal joint the longest, without hairs at th apex. No hairs on the labium. Labrum narrow, rounde anteriorly and ciliated, rather long and slightly narrowed to th base. The galea of the maxilla shows an obscure dividing lin The abdomen is short, petiolate; the hypopygium has a spine o each side near the base, and is produced either narrowly or tr angularly to the base of the apical spine. The third cubital ce is long and receives the second recurrent nervure at about on third of the distance from the base to the apex. The claspers a very long and slender.

♀. Head flat, quadrate, broader than the prothorax, the ma illary palpi (according to Erichson) six-jointed; the mandibl not bidentate. The prothorax is deeply excavated in the know species, the median segments rather short, and the tarsal ungu simple. The pygidium varies a good deal.

Type *A. bicolor* Erichs.

Key to the Species of Ariphron.

♂♂. i. Antennæ bright orange.
- A. Wholly black.
  - *a.* Median segment coarsely rugulose. — *A. petiolatus* S
  - *b.* Median segment shining, with a few shallow punctures. — *A. vagulus*, n.s
- B. Black and ferruginous.
  - *a.* Legs and abdomen, except segments 4-5, ferruginous. — *A. rigidulus*, n.s

ii. Antennæ black.
- A. Wholly black.
  - *a.* Wings fusco-violaceous. — *A. hospes*, n.s
  - *b.* Wings fusco-hyaline.
    - a^2. Median segment punctured. — *A. blandulus*, n.s
    - b^2. Median segment smooth. — *A. rixosus* S
  - *c.* Wings hyaline, iridescent. — *A. nudulus*, n.s
- B. Abdomen and legs at least ferruginous or testaceous.
  - *a.* Margins of prothorax yellow, abdomen and legs ferruginous. — *A. tryphonoides* S
  - *b.* Wholly testaceous. — *A. pallidulus*, n.s

much broader than prothorax, as broad as long
er.
broadly transversely truncate at apex.
ous; abdomen, except pygidium, black.
A. bicolor Erichs.
erruginous-brown. *A. tryphonoides* Sm.
more elongate, very narrowly rounded at apex,
ong median carina.
uginous, abdomen black. *A. blandulus*, n.sp.
broader than prothorax, rather longer than broad.
aceous. *A. nudulus*, n.sp.

ARIPHRON BICOLOR Erichs.

lor Erichs., Arch. f. Naturgesch. viii. Pt. 1, p. 264,
842(♀).
his fine species is still unknown.

A. PETIOLATUS Sm.

olatus Sm., Cat. Hym. B.M. vii. p. 36, n. 94, 1859(♂)
um has a spine on each side near the base, thence
produced with parallel sides to the base of the
The clypeus is narrowly produced anteriorly and
m the base, not reaching the apex.

urne, Vic. (French); Hunter River, N.S.W.;

pecimens are 12-13 mm. in length, those from
The type is from the Hunter River, and is
size.

A. VAGULUS, n.sp.

oduced anteriorly, very narrowly truncate at the
edian longitudinal carina from the base to the
of the clypeus finely and densely punctured and
with rather long grey pubescence. Head and
d, median segment shining, sparsely and shallowly
r than in *A. petiolatus* Sm., narrowed and rounded
bdomen slenderer than in *A. petiolatus*, the petiole

longer and more gradually widened, the second segment depressed at the base above. The whole abdomen shining, smooth on the basal segments, densely and shallowly punctured on the two or three apical segments. Hypopygium with an acute spine on each side, thence very narrowly produced with parallel sides, narrowing slightly and abruptly into the apical spine. Black; the antennæ bright orange, the clypeus at the apex, the mandibles and two minute spots between the antennæ fuscous. Length 11 mm.

♀. Unknown.

Hab.—Victoria (French).

Near *A. petiolatus* Sm., from which it may be easily distinguished by the shining median segment and the slender abdomen.

A. HOSPES, n.sp.

♂. Head broad, slightly and widely emarginate posteriorly, occiput with rather sparse, fine, shallow punctures, front densely and coarsely punctured. Clypeus with a strong median longitudinal carina, densely clothed with white pubescence. Thorax punctured, most finely on the prothorax; the anterior margin of the prothorax slightly raised, with a narrow, smooth, depressed line behind it. Scutellum broadly rounded posteriorly. Median segment rounded to the apex, very finely punctured. Abdomen petiolate, oval, shining, subpunctate; the epipygium rugose, with a delicate median carina. Hypopygium with a spine on each side near the base, thence narrowly produced and rounded at the apex, with a sharp apical spine. Beneath the abdomen is more strongly punctured, the first segment has an oblique triangular truncation at the apex. Hind trochanters with an acute spine beneath. Entirely black. Wings fusco-hyaline, with violet reflections, lighter at the base and apex, nervures fuscous. Length 14 mm.

♀. Unknown.

Hab.—Australia.

Type in Oxford University Museum, ex Coll. Saunders.

A. BLANDULUS, n.sp.

with a longitudinal median carina from the base to rowly produced and truncate at the apex, thickly grey pubescence. Head densely punctured, pubes- short, shallow sulca between the antennæ, and a a from the vertex to between the two posterior ax densely punctured, most coarsely on the meso- lum broadly rounded at the apex. Median segment red-rugulose, clothed with grey pubescence. Abdo- nd shining, subpetiolate; a rather deep depression of the second segment. Epipygium with a few es, pubescent; hypopygium with a spine on each base, thence sharply narrowed into a long apical ely black, with ashy-grey pubescence. Wings fusco- ne at the base. Nervures black. Length 11 mm.

bquadrate, large, very much broader than the thorax, unctured; the front opaque, very finely and densely e punctures confluent longitudinally. A short, fine the antennæ, and a slight median depression on The mandibles short and blunt. Prothorax narrow d anteriorly, the anterior half with the margins g a prominent cordiform carina, the enclosed area centre of the prothorax transversely elevated and portion oblique. The mesothorax very small, raised terior margin of the prothorax; the median segment the base, much broadened to the apex, with a few nctures, shorter than the prothorax. Abdomen punctured, the first segment vertically truncate at third segment the broadest. Epipygium with a carina from the base to the apex. Ferruginous, black, the pygidium and the margins of the segments gth 9 mm.

wick, Vic.

Coll. Froggatt.

A. RIXOSUS Sm.

Thynnus rixosus Sm., Desc.n.sp.Hym. p.168, n.27, 1879(♂).
Hab.—Champion Bay, W.A.

A. NUDULUS, n.sp.

♂. Clypeus with a median carina from the base to the apex, narrowly produced anteriorly. Head finely punctured, with thin, short, grey pubescence. The thorax is a little more strongly punctured than the head, the scutellum short, broadly rounded at the apex; the median segment obliquely depressed at the apex, smooth and shining at the base, delicately punctured on the apical portion. Abdomen subpetiolate, smooth and shining; epipygium strongly punctured. Hypopygium with a small spine on each side, thence gradually narrowed to the apical spine. Black; the apex of the sixth abdominal segment and the pygidium fuscous; spines of the tibiae testaceous. Wings hyaline, iridescent, nervures black. Length 8 mm.

♀. Head quadrate, finely punctured; a short sulca between the antennæ, broader than the prothorax. Prothorax a little longer than wide, with a deep excavation on each side of the anterior portion, divided by a prominent median carina; the mesothorax small; the median segment subtriangular, abruptly truncate posteriorly, flat above and sparsely punctured. Abdomen subcylindrical, shining, very delicately punctured, the fifth segment emarginate at the apex, epipygium lanceolate, with a strong longitudinal median carina. Entirely light castaneous-brown. Length 5 mm.

Hab.—Tweed River, N.S.W.

Types in Coll. Froggatt, without locality, but the locality on another male is as given.

A. RIGIDULUS, n.sp.

♂. Clypeus with a median longitudinal carina, narrowly produced anteriorly and truncate at the apex, clothed with grey pubescence; front coarsely rugulose, occiput shallowly punctured. Prothorax short, shining, depressed anteriorly; mesothorax and

ngly punctured. Median segment short, rounded, small shallow punctures. Abdomen petiolate, hining, the second segment depressed at the base. shorter than in most of the species of the genus, spine near the base, then gradually narrowed to the ical spine, which is slightly recurved. Black; the rufo-testaceous-black at the apex; antennæ, except of the scape, the legs, except the coxæ and tro- first, second and basal half of the third and the vo apical abdominal segments bright rufo-testaceous. vo-hyaline, nervures testaceous, the stigma fuscous.

.

ourne, Vic.(French).

A. TRYPHONOIDES Sm.

yphonoides Sm., Cat. Hym. B.M. vii. 34, n. 86, 1859(♂); . B.M. vii. p.68, 1859(♀).

description does not refer to the sculpture. The carina from the base not reaching the apex, th, thinly clothed with long cinereous pubescence. ensely punctured. Prothorax very shallowly, ore strongly, median segment finely and densely bdomen shining, the hypopygium with a spine on the base, thence sharply narrowed into the apical s long and slightly recurved. The six or seven f the antennæ are produced and narrowed beneath The cubital nervure is bent at the point of recep- rst recurrent nervure, having beyond that point earance of being a continuation of the first recurrent f the cubital nervure. The division of the first indicated by a faint scar only.

adrate, much broader than the thorax, punctured, between the antennæ divided by a median suture, le at the base of the mandibles, which are simple. portion of the prothorax depressed, with a median e lateral margins slightly raised, having a depres-

sion on each side of the carina; the prothorax posteriorly much elevated and somewhat narrowed, forming a subtubercular prominence as high as the mesothorax. Median segment punctured, short, much broadened and vertically truncate posteriorly. Abdomen shining, finely punctured; epipygium broadly truncate at the apex. Entirely ferruginous-brown. Length 7 mm.

Hab.—Adelaide, S.A.; Victoria.

A. PALLIDULUS, n.sp.

♂. Clypeus narrowly produced to the apex, finely punctured, with an indistinct carina from the base not quite reaching the apex. Head strongly punctured, with a well developed median frontal sulca. Prothorax very short and depressed; mesothorax strongly punctured, the scutellum short and broadly truncate at the apex. Median segment shining, sparsely punctured, the punctures very minute and shallow. Abdomen flattened above and beneath, smooth and shining, subpetiolate, the second segment depressed at the base. Hypopygium with a spine on each side near the base, thence very suddenly narrowed and produced, very slender, with parallel sides to the base of the apical aculeus, which is rather long. Testaceous-brown, the clypeus, front, margins of the prothorax, and postscutellum testaceous-yellow; the antennæ, except the scape and two basal joints of the flagellum, black. Length 9 mm.

♀. Unknown.

Hab.—Cairns, Q.

Genus TACHYNOMYIA Guér.

Tachynomyia Guér., Mag. de Zool. xii. 1842 (nec Ashmead).
Aelurus Westw., (nec Klug) Arc. Ent. ii. 2, p.122, 1844.
Aelurus Sm., Cat. Hym. B.M. vii. 53, 1859.
Pseudaelurus Ashm., Canad. Ent. xxxv.

♂. Head broad, the sides with a beard of long curled hairs, beneath strongly concave. The clypeus is moderately advanced, more broadly than in *Ariphron*; the cheeks are produced into a spine or tubercle at the base of the mandibles. The maxillæ are

g hairs, the maxillary palpi have the basal joint
he three apical joints much elongated, not quite
der as in *Aelurus*. The division of the galea is
labium has a tuft of very long hairs at the apex,
nt of the labial palpi is long, swollen at the apex
ith a cluster of very long hairs (nearly absent in
d species). The abdomen is subpetiolate and the
ned, the latter varying much in shape. Labrum
a long petiole.

coarsely punctured, the head more or less convex,
imple, the labial palpi four-jointed, the basal joint
axillæ and maxillary palpi very minute, rudi-
um usually simple; tarsal ungues simple in some
most.

minalis Guér.

amply distinct from *Aelurus* Klug, with which
by Westwood and Smith. Ashmead has perceived
erences, but has got into confusion by a wrong
T. spinolæ, which he erroneously regards as the
omyia. *T. abdominalis* is described in Guérin's
spinolæ, and should therefore be the type of the
sed for the two, which are in my opinion varieties
cies. Ashmead's genus *Pseudaelurus* must sink

Key to the Species of Tachynomyia.

um with parallel sides, subconical at apex, with
l spine at the apex.
right ferruginous.
n and postscutellum marked with yellow.
T. abdominalis Guér.
abdomen entirely ferruginous-brown. *T. concolor*, n.sp.
with parallel sides, subconical or subtruncate at
ith two small notches on one or both sides of the
e.
third abdominal segments ferruginous.
with a strong median carina. *T. basalis* Sm.
without or almost without a carina. *T. rubella* Sm.

b. entirely black.
*a*². Abdominal segments constricted. *T. paradelpha*, n.sp
*b*². Abdominal segments not constricted.
*a*³. Pubescence on head fulvous. *T. obliterata*, n.sp
*b*³. Pubescence on head grey. *T. senex* Sm
c. Tibiæ and tarsi ferruginous. *T. punctata* Sm
C. Hypopygium emarginate at the apex, with an apical spine.
a. Second and third abdominal segments ferruginous.
*a*². Postscutellum black; mesothorax shining, sparsely punctured. *T. seduloides*, n.sp
*b*². Postscutellum yellow; mesothorax opaque, closely punctured. *T. volatilis* Sm
b. Black, with ferruginous legs.
*a*². Anterior margin of the prothorax and the postscutellum yellow. *T. fervens* Sm
D. Hypopygium broadened from the base to the apex, where it is emarginate with a long apical spine.
a. Black, the legs ferruginous. *T. abstinens*, n.sp
E. Hypopygium subtriangular, the sides serrate; apical spine very short.
a. Black, the legs ferruginous.
*a*². Abdomen coriaceous, clothed with fine pubescence. *T. pilosula* Sm
F. Hypopygium rounded, with a short apical spine.
a. Second and third abdominal segments ferruginous.
*a*². Pubescence on the front pale golden. *T. aurifrons* Sm
b. Sides of all the abdominal segments ferruginous.
*a*². Anterior margin of the prothorax yellow. *T. combusta* Sm
c. Black, the legs ferruginous or fuscous from near the base of the femora. *T. moerens* Westw
G. Hypopygium with a lateral spine on each side near the base or with prominent angles, thence gradually narrowed to the base of the apical spine.
a. Hypopygium rounded at the base of the apical spine.
*a*². Wings hyaline, crossed with a fuscous band.
*a*³. Scutellum with an apical emargination and a small tubercle on each side.
*a*⁴. Postscutellum and anterior margin of the prothorax white. *T. fascipennis*, n.sp
*b*³. Scutellum without tubercles or emargination.
*a*⁴. Wholly black. *T. anthracina* Sm
*b*². Wings hyaline, iridescent.
*a*³. Postscutellum and anterior margin of the prothorax white. *T. flavopicta* Ritsema

♀♀. A. First abdominal segment with a distinct transverse carina before the apex.

a. Head black, thorax and legs ferruginous. Sparsely punctured. *T. abdominalis* Guér.

b. Black, thorax and legs ferruginous. Closely punctured. *T. punctata* Sm.

B. The carina before the apex of the first abdominal segment either absent or indistinct.

a. Tarsal ungues bifid.

a^2. Abdominal segments closely and finely punctured. *T. adusta* Sm.

b^2. Abdominal segments sparsely punctured, the punctures large. *T. incana* Sm.

b. Tarsal ungues simple.

a^2. Strongly punctured. Second abdominal segment broadly emarginate on the apical margin.

a^3. Head not much narrowed posteriorly. *T. anthracina* Sm.

b^3. Head much narrowed posteriorly. *T. fascipennis*, n.sp.

C. Pygidium contracted at the base.

a. Sparsely punctured. Second abdominal segment not emarginate on the apical margin. *T. flavopicta* Ritsema.

T. ABDOMINALIS Guér.

Agriomyia (*Tachynomyia*) *abdominalis* Guér., Mag. de Zool. xii. p.5, 1842(♂).

Aelurus abdominalis Westw., Arc. Ent. ii. 2, p.122, 1844(♂).

Agriomyia (*Tachynomyia*) *spinolæ* Guér., Mag. de Zool. xii. p.6, 1842(♂).

Thynnus fervidus Erichs., Arch.f.Naturgesch. viii. Pt.1, p.263, n.237, 1842(♂).

Thynnus abdominalis D.T., Cat. Hym. viii. 100, 1897(♂) [nec Fabr.].

This species may be recognised by the light ferruginous colour of the abdomen with the basal segment black. *T. spinolæ* Guér., seems to be merely a colour-variety, as Guérin himself suggests. In spite of this Ashmead makes the two forms the types of distinct genera, erroneously choosing *spinolæ* as the type of *Tachynomyia*. I have seen specimens in which the black colour of the thorax is replaced by a ferruginous-red as noticed by Smith, and also intermediate forms.

♀. Head convex, subquadrate, shining and sparsely punctured, a faint median sulca on the front; prothorax broader than long, the sides parallel; mesothorax narrowed posteriorly; median segment broadened posteriorly and obliquely truncate; thorax and median segment sparsely punctured. First abdominal segment with a transverse depression just before the apex, the apical margin recurved, forming a raised carina; second segment with a transverse carina close to the base, a transverse depressed line following it; the apical margin depressed, with a transverse row of fine punctures. All the segments punctured, the three basal sparsely, the three apical finely and densely. Abdomen beneath finely punctured, the first segment with an acute tubercle at the base. Tarsal ungues simple. Fuscous; the head black; thorax, median segment and legs ferruginous; antennæ, except the scape, and the two apical abdominal segments fusco-ferruginous. Length 9 mm.

Hab.—Victoria; Tasmania.

The female is described from a specimen in the Oxford University Museum collected by Bakewell.

T. CONCOLOR, n.sp.

♂. Clypeus punctured, with a median carina from the base to near the middle, a smooth, longitudinal, median line below the carina, the apex smooth and rather narrowly truncate, the sides densely covered with long fulvous pubescence. Head finely rugulose, with fulvous pubescence on the front and a beard of long fulvous hairs on the sides. Prothorax almost smooth, the anterior margin raised, mesothorax and scutellum punctured, the scutellum broadly truncate at the apex. Median segment long, shining, almost smooth, very slightly depressed at the base. Abdomen slender, subpetiolate, almost smooth: the first segment with a deep median sulca from the base not reaching the apex. Epipygium punctured. Hypopygium prominent; the sides curving upwards, nearly parallel, slightly diverging to the apex; the apical margin subconical, ciliated, the apical spine slightly recurved. Ferruginous-brown, the head and flagellum of the

the clypeus ferruginous, its apical margin dull
14 mm.

k, Vic.
Froggatt.

T. BASALIS Sm.

s Sm., Cat. Hym. B.M. vii. p.55, n.8, 1859(♂).
hoferi D.T., Cat. Hym. viii. 115, 1897.
lia.

T. RUBELLA Sm.

us Sm., Cat. Hym. B.M. vii. 56, n.11, 1859(♂).
richii D.T., Cat. Hym. viii. 107, 1897.
his species seems to be lost. It is very near the
has no central carina on the clypeus, and the
abdomen appears to be different. It is also a

Plenty, Vic.(Bakewell).

T. PARADELPHA, n.sp.

nsely clothed with cinereous pubescence, advanced
ncate at the apex. Head and thorax rugulose,
ced into a short blunt spine at the base of the
ith a long beard of curled cinereous hairs. The
fulvous and thin on the front and the mesonotum,
ick on the occiput, prothorax and median seg-
segment delicately reticulate, finely punctured at
se. Abdomen subpunctate, first segment short
n is usual in the genus, a strong median sulca
ot reaching the apex, and a very obscure carina
the sulca to the apex. Second segment with a
rina from near the base to the apex; a similar
visible, on the third segment. Segments 2-4 with
tion on each side near the apical margin; the
the third and fourth slightly constricted near

the base. Hypopygium almost truncate at the apex, with a strong apical spine, the apical angles produced into very short spines, and the margin notched, giving it a serrated appearance. Antennæ rather shorter than in the allied species. Entirely black. Wings hyaline, nervures fuscous. Length 14 mm.

Hab.—Victoria (French).

Somewhat resembles some species of *Thynnoides*, but the mouth-parts show it to be a true *Tachynomyia*.

T. OBLITERATA, n.sp.

♂. Head finely rugulose, densely clothed with long fulvous pubescence, and a long beard of the same colour on the sides; a short, sharp spine at the base of the mandibles. Clypeus clothed with long golden pubescence, with a carina from the base to the apex. Prothorax finely, mesothorax and scutellum more coarsely rugulose; the scutellum short, broadly truncate at the apex; the prothorax thickly, the mesothorax more thinly clothed with fulvous pubescence. Median segment finely reticulate, punctured at the extreme base, with long griseous pubescence on the sides. Abdomen subpunctate, ovoid, the sculpture very shallow and indistinct, a sulca on the first segment from the base almost reaching the apex, second segment depressed at the base, the pubescence on the sides of the abdomen griseous, on the epipygium pale fulvous. Hypopygium with a slightly recurved apical spine, a short blunt tooth on the apical margin, close to the base of the apical spine, and another at the apical angle rather longer and more acute, giving the apical margin the appearance of being doubly notched on each side. Black; the mandibles fuscous at the apex, the tegulæ and the spines of the tibiæ and tarsi fusco-ferruginous. Length 11 mm.

♀. Unknown.

Hab.—S. Australia.

Type in Coll. Froggatt.

T. SENEX Sm.

Aeleurus senex Sm., Cat. Hym. B.M. vii. p.54, n.5, 1895(♂).
Thynnus schroederi D.T., Cat. Hym. viii. 115, 1897(♂).
Hab.—Wagga, N. S.W.; Melbourne, Vic.

T. PUNCTATA Sm.

nctatus Sm., Cat. Hym. B.M. vii. p. 44, n. 127, 1859 (♀).
tatus Sm., Cat. Hym. B.M. vii. p. 57, n. 14, 1859 (♂♀).
nus Sm., Cat. Hym. B.M. vii. 69, 1859 (♀ nec ♂).
tenbrunneri D.T., Cat. Hym. viii. 109, 1897.

an segment is very finely rugulose and the nervures
orown.

quadrate, slightly convex, broader than long, finely
ier sparsely on the occiput. Thorax and median
: strongly punctured, the median segment much
he prothorax and obliquely truncate. The two
al segments rugose, the first with a transverse
he apex; the second and third with a smooth mark
ear the apical margin. Third, fourth and fifth
punctured, the punctures at the base of the seg-
ute. Epipygium rugulose, narrowly rounded at
fulvous pubescence. Head and abdomen black;
segment, legs, antennæ, mandibles and epipygium
s. Length 9 mm.
ide, S.A.

T. punctatus Sm., has the parts which are ferru-
e specimens dark fuscous, and has a faint, short
ont. It is in very bad condition, but I think I
ntifying it with *T. dentatus* Sm.

T. SEDULOIDES, n.sp.

advanced, narrowly truncate at the apex, with a
from the base to the centre, clothed with cinereous
nctured. Head coarsely and densely punctured;
lmost straight carina between the antennæ and
base. The sides of the head with a long beard of
Prothorax smooth and shining, the anterior
Mesothorax sparsely punctured on the disc,
ely on the sides between the sulcæ. Scutellum
rounded posteriorly. Median segment densely
bdomen with large shallow punctures; the hypo-

pygium with parallel sides, strongly emarginate at the apex, the apical angles slightly produced and the apical spine long. Beneath the first segment has a longitudinal carina from the base and is obliquely truncate at the apex. Black; the mandibles, apex of the clypeus, the carina between the antennæ, the pronotum, tegulæ, the apical half of the first, the whole of the second and third abdominal segments, and the sides of the fourth at the base and the legs, except the base of the coxæ, ferruginous. Wings hyaline, nervures fuscous, the costa testaceous.

Hab.—Berwick, Vic.

Type in Coll. Froggatt.

Near *T. basalis* Sm., in colour, but the sculpture is quite different.

T. VOLATILIS Sm.

Aelurus volatilis Sm., Trans. Ent. Soc. London, 1868, p.237(♂).
Thynnus mayri D.T., Cat. Hym. viii. 111, 1897(♂).

Hab.—S. Australia.

T. AGILIS Sm.

Aelurus agilis Sm., Trans. Ent. Soc. Lond.(3) ii. 5, p.390, 1865(♂).
Thynnus wildaueri D.T., Cat. Hym. viii. 118, 1897(♂).

Hab.—Swan River, W.A.

I have not seen this species. Smith does not refer to the shape of the hypopygium.

T. FERVENS Sm.

Thynnus fervens Sm., Cat. Hym. B.M. vii. p.58, n.15, 1859(♂).
Thynnus pernteri D.T., Cat. Hym. viii. 113, 1897(♂).

I have seen only one specimen of this species. It agrees well with Smith's description, but the abdomen is covered with large shallow punctures, not "fine, very shallow." The scutellum is large and very broadly truncate at the apex.

Hab.—Victoria.

T. ABSTINENS, n.sp.

♂. Head coarsely punctured, rugulose on the front, clypeus densely covered with pale fulvous pubescence, produced and rather narrowly truncate at the apex. The cheeks produced

ıbercle at the base of the mandibles, and with a
ard of pale fulvous hairs. Prothorax short, the
n slightly raised, sparsely and shallowly punctured.
nd scutellum coarsely punctured; median segment
ıctured at the base, finely reticulate on the apical
grey pubescence on the sides. Abdomen shining,
he first segment with a median sulca from the
reaching the apex; second segment depressed and
icted at the base. Hypopygium prominent, with
na beneath, strongly narrowed near the base, then
ened to the apex, which is strongly emarginate on
ıe long apical spine, which is slightly recurved, the
are produced into short spines. Black; the man-
inner margin and the legs, except the coxæ and
rruginous. The pubescence on the head and disc
pale fulvous, elsewhere grey. A few fulvous hairs
nargin of the hypopygium. Length 10-14 mm.
n.
oria (French).

T. PILOSULA Sm.

sulus Sm., Cat. Hym. B.M. p.56, n.10, 1859(♂).
is finely punctured, with a delicate carina from
ne apex; the head and thorax are finely rugulose,
punctured, the median segment delicately reticu-
lomen is finely coriaceous, the epipygium shallowly
The hypopygium is subtriangular with two or three
otches and a short apical spine.
oria; Sydney, N. S.W.

T. COMBUSTA Sm.

bustus Sm., Cat. Hym. B.M. vii. 55, n.9, 1859(♂).
eton Bay.

T. AURIFRONS Sm.

rifrons Sm., Cat. Hym. B.M. vii. 55, n.9, 1859(♂).
ınd thorax are rugose and opaque, the prothorax
egment shining and rugulose. Abdomen shining,

with shallow punctures, the segments smooth at extreme base and apex. The scutellum is broadly truncate at the apex.

Hab.—Albany, W.A.

T. MOERENS Westw.

Aelurus moerens Westw., Arc. Ent. ii. 2, 124, 1844(♂).

Aelurus incanus Sm., Cat. Hym. B.M. vii. p.53, n.4, 1859(♂).

Aelurus vulpinus Sm., Cat. Hym. B.M. vii. p.54, n.7, 1859(♂).

Thynnus schoberi D.T., Cat. Hym. viii. 115, 1897.

♂. The clypeus has the anterior region narrowly pale yellow; the colour of the legs varies from fuscous to ferruginous.

♀. Head, thorax, median segment and two basal abdominal segments coarsely rugose, the head slightly convex, much broader than long, with a deep depression on each side between the eye and the base of the antenna. Prothorax broader than long; median segment short, obliquely truncate posteriorly, the surface of the truncation finely rugulose. The tarsal ungues bifid. The apical margin of the first abdominal segment raised, forming a transverse carina, and a well marked transverse carina near the base of the second segment. The remaining segments punctured, most sparsely on the sides, almost smooth at the base. Epipygium finely rugulose, narrowly rounded at the apex. Fuscous, antennæ and legs ferruginous. Length 13 mm.

Hab.—Shoalhaven, Bombala, N. S.W.; Melbourne, Vic.

The female described by Smith (Cat. Hym. B.M. vii. 69) is that of *T. dentatus* Sm.

T. ADUSTA Sm.

Thynnus adustus Sm., Cat. Hym. B.M. vii. p.43, n.122, 1859(♀).

♀. Head and thorax coarsely punctured, the punctures confluent; the head convex, much broader than long, very strongly rounded at the posterior angles. Median segment longer than usual in the genus, broadened posteriorly and obliquely truncate. The two basal abdominal segments rugose, the apical margin of the basal segment forming a strongly raised carina with a depressed transverse line in front of it. Second segment with a transverse carina close to the base, nearly covered by the first

e remaining segments finely and densely punctured, sparsely and deeply on the apical portion of the smooth, shining mark on each side of the third ments near the apical margin. Pygidium rugulose, e extreme apex, with a faint median longitudinal l ungues bifid. Fuscous; legs, mandibles, clypeus fusco-ferruginous. Length 13 mm.

n.

ralia.

T. ANTHRACINA Sm.

hracinus Sm., Descr. n.sp. Hym. p.174, 1879(♂♀).
*üller*i D.T., Cat. Hym. viii. 111, 1897(♂♀).

subtriangularly produced, clothed with whitish nd a median longitudinal carina from the base to e head densely punctured, a beard of grey hairs on ounded carina between the antennæ. Prothorax ort, the anterior margin curved backwards at the uced. The whole thorax densely punctured, most prothorax. Scutellum short, broadly subtruncate Median segment very closely and finely punctured, bescence on the sides. Abdomen subpetiolate, ining, the two apical segments with shallow punc- ygium with a sharp angle on each side near the roadly produced and rounded at the base of the Black. Length 13-15 mm.

rounded to the hind margin, very strongly punc- very delicate, short, frontal sulca. Thorax and nt strongly punctured; the prothorax broader than lian segments broadened and obliquely truncate Tarsal ungues simple. The two basal abdominal ose, the rest longitudinally punctured-rugose, the ncate at the apex, with a low broad median carina. smooth at the base. Fusco-ferruginous. Length

en, Mackay, Q.

T. FASCIPENNIS n.sp.

♂. Clypeus very narrowly advanced and truncate at the ape densely clothed with cinereous pubescence, with a strong media carina from the base to the apex. Head strongly and ver closely punctured, the interantennal prominence very broadl rounded at the apex; posterior margin of the head straight, finel and closely punctured on the vertex and behind the eyes; th sides with a beard of long grey hairs. Prothorax short an broad, finely punctured, the anterior angles prominent an recurved. Mesothorax finely punctured, a raised oblique carir on each side above the tegulæ. Scutellum prominent, almo vertically truncate posteriorly, the apex strongly emarginat the angles forming a slight tubercle on each side. Media segment rounded, finely reticulate, with grey pubescence on th sides. Abdomen subpetiolate, elongate-ovoid, shining, su punctate; the first segment narrower at the apex than in *anthracinus* Sm., with a very short median sulca from the bas Third and fourth segments wider than the second. Hypopygiu with a spine on each side near the base, thence gradual narrowed to the base of the apical spine, where it is narrow rounded. Black; the postscutellum white. Wings hyalin nervures fuscous; a broad irregular fuscous band crossing th forewing from the stigma. Length 11-14 mm.

♀. Head, thorax, and median segment coarsely rugose; th head gradually narrowed to the posterior margin, where it narrower and not so strongly rounded at the posterior angles in *T. anthracina* Sm. The prothorax is broadest in the middl the median segment rather shorter than the prothorax, mu broadened to the apex, where it is almost vertically truncat Abdomen longitudinally rugulose, rugose on the two basal se ments. Segments 3-5 almost smooth at the base; the epipygiu with a delicate, median, longitudinal carina. Dark fuscous; th mandibles, antennæ, and legs fusco-ferruginous. Length 9-13mı

Hab.—Cairns, Q.

Very near *T. anthracina* Sm., from which it differs in the ma by the shape of the scutellum and the white colour of the pos

scutellum. The shape of the head in the female is different, and the median segment is more abruptly truncate.

T. FLAVOPICTA Ritsema.

Aelurus flavopictus Ritsema, Ent. Mag. xii. p.185, 1876(♂).
Thynnus seemülleri D.T., Cat. Hym. viii. 115, 1897.

♂. Clypeus narrowly advanced, very finely punctured, smooth at the apex, with a carina from the base almost reaching the apex, thinly clothed with grey pubescence. Head punctured, the sides with a beard of cinereous pubescence, the cheeks bluntly produced at the base of the mandibles, a delicate longitudinal carina from the vertex, almost reaching the anterior ocellus. Prothorax short and broad, not produced at the angles, very sparsely punctured. Mesothorax and scutellum punctured, the scutellum short, truncate at the apex; median segment opaque, pubescent, punctured-rugose. Abdomen smooth and shining, the petiole long and slender, the second segment depressed at the base. Hypopygium with a spine on each side near the base, thence gradually narrowed, the apical spine very short. Black; the anterior margin of the clypeus, two small spots between the antennæ, the anterior margin of the prothorax, narrowly interrupted in the middle, the tegulæ and the postscutellum yellowish-white. Wings hyaline, faintly iridescent, nervures black. Length 11 mm.

♀. Head, thorax, and median segment strongly and rather sparsely punctured; head subquadrate, slightly convex, rounded at the posterior angles; prothorax subquadrate, rather broader than long; mesothorax narrowed posteriorly; median segment short, much broader at the apex than the base, obliquely truncate posteriorly, the surface of the truncation very densely and finely punctured. The thorax narrower than the head or abdomen. Abdomen with the first segment vertically truncate at the base, the three basal segments strongly and rather sparsely punctured, the apical margins slightly depressed; fourth and fifth segments densely covered with fine, shallow punctures. Pygidium contracted at the base, narrow, widened to the apex, where it is

rounded, with a median, longitudinal carina. Dark fuscous, the head black; mandibles, antennæ, legs and pygidium ferruginous. Length 9 mm.

Hab.—Mackay, Q.(♂♀ in cop.), Cairns, Cape York, Q.

Described by Ritsema from an Aru specimen. In Aru specimens the scutellum is rather longer, and more rounded than truncate at the apex.

T. BARBATA Sm.

Aelurus barbatus Sm., Cat. Hym. B.M. vii. p.57, n.13, 1859(♂♀).

I have not seen this species, and the type, which was in Bakewell's Collection, appears to be lost. The female seems to be distinguished from that of all other species of the genus by the sculpture of the second abdominal segments.

Species of *Tachynomyia* have been described from the Austro-Malayan region and not yet recorded from Australia as follows:

1. T. COMATA Sm.

Aelurus comatus Sm., Journ. Proc. Linn. Soc. Zool. vii. p.27, 1863(♂).

Hab.—Waigiou.

2. T. FRAGILIS Sm.

Aelurus fragilis Sm., Journ. Proc. Linn. Soc. Zool. viii. p.78, 1864(♂).

Hab.—Morty.

3. T. INSULARIS Sm.

Thynnus insularis Sm., Journ. Proc. Linn. Soc. Zool. vii. p.26, 1863(♀).

Hab.—Mysol.

The following species which have been described as belonging to *Tachynomyia* or *Aelurus* should in my opinion be placed elsewhere:—*Tachynomyia caelebs* Sauss., *Tachynomyia nitens* Sauss., and *Aelurus fulvifrons* Sm. These will be dealt with in a later paper.

...IONS TO A KNOWLEDGE OF AUSTRA-...AN FORAMINIFERA. PART II.

...RD, B.A., B.Sc., JUNIOR DEMONSTRATOR IN BIOLOGY, ...NIVERSITY, AND H. I. JENSEN, B.Sc., LINNEAN ...FELLOW OF THE SOCIETY IN GEOLOGY.

...tinued from Proceedings, 1904, p. 831.)

(Plate vi.)

...night be taken as an addition to the work pub-...r other of us in the Records of the Australian ...i., Pt. 4, or in the Proceedings of the Linnean ... South Wales, 1904, p.810.

...oraminiferal sands examined have been obtained ... made by Mr. C. Hedley, F.L.S., of the Australian ... fossil material has kindly been supplied by Miss ...Launceston Museum, Tasmania.

...s recorded in this and our previous papers having ...from localities on and about the Australian coasts ...om one another, have enabled us to make deduc-...g the distribution of Foraminifera in Australian ...o in connection with the conditions of climate and ...he time of the laying down of the Table Cape

...feral sands from Van Diemen's Inlet, Gulf of ...ntaria; muddy bottom; depth 2 fathoms.

Family MILIOLIDÆ.

Subfamily **MILIOLININÆ.**

... IRREGULARIS d'Orb.; diminutive.

...INA LIMBATA d'Orb.; diminutive.

...A Brady.

...SEMINULUM Linn ; diminutive.

5. M. ALVEOLINIFORMIS Brady; diminutive.
6. M. RETICULATA d'Orb.
7. M. CIRCULARIS Bornem; diminutive.
8. M. UNDOSA Karrer.

Subfamily **HAUERININÆ.**

9. OPHTHALMIDIUM INCONSTANS Brady.
10. PLANISPIRINA EXIGUA Brady.
11. P. CELATA Costa.
12. P. (SIGMOILINA) SIGMOIDEA Brady.

Subfamily **PENEROPLIDINÆ.**

13. ORBITOLITES sp.; fragments.

Family LITUOLIDÆ.

Subfamily **TROCHAMMININÆ.**

14. TROCHAMMINA RINGENS Brady.
15. WEBBINA CLAVATA P. & J.

Subfamily **LITUOLINÆ.**

16. HAPLOPHRAGMIUM FONTINENSE Terq.

Family TEXTULARIIDÆ.

Subfamily **TEXTULARIINÆ.**

17. TEXTULARIA CONCAVA Karrer.
18. T. GRAMEN d'Orb.
19. VERNEUILINA SPINULOSA Reuss.
20. CLAVULINA CYLINDRICA Hantk.
21. SPIROPLECTA AMERICANA Ehrenb.

Subfamily **BULIMININÆ.**

22. BOLIVINA COSTATA d'Orb.
23. B. TEXTULARIOIDES Reuss.
24. BULIMINA INFLATA Seg.
25. VIRGULINA SUBSQUAMOSA Egger.

Family CHEILOSTOMELLIDÆ.

OMELLA OVOIDEA Reuss.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

SPERA Reuss.
OSTATA Reuss.
HORA Ry. Jones (nonapiculate variety).
A Reuss.
YANA Seg.

Subfamily NODOSARIINÆ.

A SCALARIS Batsch, var. SEPARANS Brady.
RIA VORTEX F. & M.

Subfamily POLYMORPHININÆ.

PHINA ELEGANTISSIMA P. & J.
A PYGMÆA d'Orb.
RUPTA Brady.
IENSIS d'Orb.
GERI Brady.

Family GLOBIGERINIDÆ.

INA BULLOIDES d'Orb.
IDES var. TRILOBA Reuss.
CEA d'Orb.
ATERALIS Brady.
OBATA Brady.
Egger.
TA Brady.
A UNIVERSA d'Orb.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

NA BICONCAVA P. & J.
IENSIS d'Orb.

49. D. ARAUCANA d'Orb.
50. TRUNCATULINA HAIDINGERII d'Orb.
51. T. UNGERIANA d'Orb.
52. ANOMALINA ARIMINENSIS d'Orb.
53. PULVINULINA AURICULA F. & M.
54. P. MENARDII d'Orb.
55. P. PATAGONICA d'Orb.
56. P. CANARIENSIS d'Orb.
57. ROTALIA CLATHRATA Brady.
58. R. PAPILLOSA Brady.
59. CARPENTERIA PROTEIFORMIS Goës.
60. RUPERTIA STABILIS Wallich.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

61. NONIONINA SCAPHA F. & M.
62. POLYSTOMELLA MACELLA F. & M.

Subfamily NUMMULITINÆ.

63. AMPHISTEGINA LESSONII d'Orb.

New Species and Varieties.

TEXTULARIA QUADRILATERA (?) Schwager, var.
(Plate vi. fig. 1).

The test is almost hyaline, approaching that of Bulimininæ in appearance, faintly brownish in tinge from foreign material. It is larger than the types described in the Challenger Reports; the proximal end is rounded, and therefore does not agree in this respect with Schwager's type-form, which is acutely pointed. The distal end containing the aperture is missing.

The test is very flat and remarkable for its straight contour, reminding one of the appearance of a pteropod shell; it has a thickened rim of hyaline supplemental skeleton.

CRISTELLARIA VARIABILIS Reuss, var. ALLOMORPHINOIDES, var.nov. (Plate vi. fig.2).

This is a minute hyaline shell, the last chamber of which envelops the earlier chambers and is shaped like *Lagena orbignyana*, but has a cristellarian aperture. The enclosed earlier chambers have an arrangement which reminds one of that of the internal chambers of *Allomorphina trigonula*, but they open into one another by cristellarian necks. In section the shell is rather flattened. Size: length 0·35, breadth 0·25 mm.

Note.—The figure represents the shell seen by transmitted light.

Remarks.—About 20 % of this material is made up of foraminifera, the remaining portion consisting of sand, shell-fragments, one or two species of ostracod shells, polyzoa, and spicules of sponges, echinoderms and alcyonarian corals. A few pteropod shells are also present.

The members of the family Miliolidæ are not well represented in numbers, and are uniformly diminutive in size. This is to be attributed to the fact that the material was dredged in muddy and very shallow water, whereas members of the family thrive best in clear water at a depth of from 50 to 150 fathoms. The great amount of fresh water brought down by rivers to the Gulf also brings about conditions unfavourable to the perfect development of the Miliolidæ.

Members of the family Textulariidæ are extremely abundant as regards numbers of individuals, but are limited to comparatively few species and those of a small size. The forms present are such as are not restricted to great depths, and, like *Textularia gramen* and *Bolivina costata*, usually found in shallow waters. Yet all these species belong to deeper water than they were found in. To this and to the abundance of brackish water we may attribute the minuteness of the forms obtained.

The Globigerinidæ are extremely abundant. This is very remarkable, as this family is pelagic, and properly speaking, belongs to deeper waters. The species represented are, however, all micromorphs.

The Lagenidæ are represented chiefly by species of *Uvigerina*. According to Carpenter this genus belongs, properly speaking, to depths between 100 and 300 fathoms. All the forms present are micromorphs. The genus *Lagena* is very poorly represented as regards number of individuals. This is to be expected, as the genus flourishes best at depths of 50 fathoms. The species present here are delicate, unstriated and nonapiculate.

The Rotaliidæ are well represented, comparatively speaking, both as regards species and numbers. The occurrence of specimens of *Rotalia clathrata* is interesting, as verifying Carpenter's remarks regarding the adaptability of the genus *Rotalia* to estuarine conditions. Although the water is shallow, the genus *Discorbina* is represented by minute forms only.

Nothing is more noticeable in an examination of this sand than that the foraminifera in it are characteristic of deeper water than that in which they occur, and show a marked tendency towards diminution in size. We would suggest, as a likely explanation of this, that the Gulf of Carpentaria is a remnant of a larger Tertiary sea, the floor of which has been undergoing elevation, eliminating the weaker oceanic forms and reducing the size of the hardier ones.

The absence of forms like *Tinoporus* and *Calcarina*, and the rarity of *Amphistegina* and *Orbitolites* might at first sight be taken as evidence that the forms present do not represent a true, stationary, littoral fauna; but this feature might also be explained on the grounds of brackish and muddy conditions.

A glance at the geological map of Queensland shows the Gulf to be surrounded by late Tertiary and alluvial strata.

2. *Foraminifera dredged at a depth of 15 fathoms off Palm Island near Townsville, Q., by C. Hedley.*

The coarser sands from this locality were examined by one of us (H. I. J.) in 1903, and a list of forms present was published in the Proceedings of this Society for 1904. The eighteen species already recorded are omitted in this list, which comprises the

s, except a few which are very abundant in the coarse sands.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

RETICULATA d'Orb.
LUM Linn.
ARIS Reuss.
NA d'Orb.
ULATA Brady.
LINA TENUISEPTATA Brady.
Czjzek.
d'Orb.
Karrer.
A Karrer.
erq.
A d'Orb.
SA Chapman (Journ. Linn. Soc. Zool. Vol. xxviii. pl.19, fig.5).

Subfamily HAUERININÆ.

NA EXIGUA Brady.
IDIUM CORNU Chapman (Journ. Linn. Soc. Zool. viii. p.408, pl.36, fig.6).
ANS Brady.

Subfamily PENEROPLIDINÆ.

ES COMPLANATA Lamk.
A CHAPMANI, sp.n. (Plate vi., figs.5*a*, *b*).

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

INA CENOMANA d'Orb.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

IA TROCHUS d'Orb.
A Karrer.

22. T. SAGITTULA Defr.
23. VERNEUILINA PROPINQUA Brady.
24. V. SPINULOSA Reuss.
25. V. VARIABILIS Brady
26. GAUDRYINA PUPOIDES d'Orb.
27. CLAVULINA ANGULARIS d'Orb.

Subfamily **BULIMININÆ.**

28. BOLIVINA TEXTULARIOIDES Reuss.
29. B. PUNCTATA d'Orb.
30. B. TORTUOSA Brady.

Subfamily **CASSIDULININÆ.**

31. EHRENBERGINA SERRATA Reuss.

Family LAGENIDÆ.

Subfamily **LAGENINÆ.**

32. LAGENA STRIATA (apiculate variety) d'Orb.
33. L. GRACILLIMA Seg. (one specimen only).

Subfamily **POLYMORPHININÆ.**

34. UVIGERINA INTERRUPTA Brady.
35. SAGRINA AUSTRALIENSIS, sp.n. (Plate vi., figs. 3*a*, *b*).

Subfamily **RAMULININÆ.**

36. RAMULINA GLOBULIFERA Brady.

Family GLOBIGERINIDÆ.

37. GLOBIGERINA LINNÆANA d'Orb.
38. G. BULLOIDES d'Orb.

Family ROTALIDÆ.

Subfamily **SPIRILLININÆ.**

39. SPIRILLINA DECORATA.

Subfamily **ROTALIINÆ.**

40. DISCORBINA ARAUCANA d'Orb.
41. D. TURBO d'Orb.

42. D. PATELLIFORMIS Brady.
43. D. OPERCULARIS d'Orb.
44. TRUNCATULINA UNGERIANA d'Orb.
45. T. PRÆCINCTA Karrer.
46. ANOMALINA FOVEOLATA Brady.
47. A. POLYMORPHA Costa.
48. A. ARIMINENSIS d'Orb.
49. PULVINULINA CANARIENSIS d'Orb.
50. P. OBLONGA Williamson.
51. P. OBLONGA var. SCABRA Brady.
52. P. TUMIDA Brady.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

53. NONIONINA BOUEANA d'Orb.
54. POLYSTOMELLA HEDLEYI Jensen.
55. P. VERRICULATA Brady.

Subfamily NUMMULITINÆ.

56. OPERCULINA AMMONOIDES Gron.

SAGRINA AUSTRALIENSIS, n.sp. (Plate vi. figs.3*a*, *b*, *c*).

This species has a uvigerine commencement, after which it consists of a uniserial row of oval chambers cylindrical in section. The character of the shell is intermediate between *S. dimorpha* and *S. virgula*. The shell is thick, and studded with large pits as in *S. dimorpha*. There are also tubercles externally approximating to the spines of *S. virgula*. The neck is as in *S. virgula*.

There is a distinct constriction at the junction of the chambers, and some of the chambers are produced outwards into small monticular prominences (see fig.3*a*). The chambers increase gradually in size.

Under a high power the surface appears as in fig.3*b*. On focussing down, canals are seen in the walls, extending from the interior and opening to the exterior in the small tubercles.

Size: length 0·7 mm.

This species is fairly common in the Palm Island dredgings.

Articulina chapmani n.sp. (Plate vi. figs.5*a*, *b*).

This is a highly ornamented species. It consists of a series of chambers, slowly increasing in size, and ending in a smaller neck-like spherical chamber with a round terminal aperture. Unfortunately in the two specimens found the proximal extremity was broken off.

The test is distinctly porcellanous. Because of this characteristic, as well as on account of the nodosarine arrangement of the chambers and their high ornamentation, we have ascribed this species to the genus *Articulina*.

As regards the ornamentation, fig.5*b* shows it under high power. The test is slightly constricted between the chambers. Each chamber bears a series of longitudinal ridges, and in each space between these there are two rows of minute tubercles.

Length 0·57 mm.

Remarks.—About 30 % of the material under examination was made up of foraminifera, the rest being composed of coral remains, polyzoa, coralline algæ, ostracods, and sponge spicules. The ostracods are particularly well represented, both in species and numbers. Glauconite casts are very rare. Miliolidæ and Nummulinidæ constitute the main bulk of the foraminifera present.

The occurrence of *Ophthalmidium cornu* and *Spiroloculina tortuosa* in considerable numbers is interesting inasmuch as these are new species described by Mr. F. Chapman in his report on the "Foraminifera from the Lagoon at Funafuti."* *Polystomella hedleyi* is very abundant and characteristic.

Bolivina is fairly well represented; other Textulariidæ, excepting *Verneuilina*, are extremely rare.

Operculina ammonoides is a very abundant form.

On the whole, the material is typical of coral reef conditions. Globigerinidæ and Lagenidæ are very rare.

* Journ. Linn. Soc. Lond. Zoology. Vol. xxviii.

3. *Fine Foraminiferal Sand dredged at a depth of 300 fathoms, 27½ miles east of Sydney Heads, by Mr. C. Hedley.*

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Miliolina cultrata Brady.
2. Spiroloculina fragilissima Brady.
3. S. grata Terq.
4. S. impressa Terq.
5. S. excavata d'Orb.
6. S. limbata d'Orb.
7. S. nitida d'Orb.

Subfamily HAUERININÆ.

8. Cerviciferina hilli, sp.n. (Plate vi., figs.7*a*, *b*).
9. Planispirina exigua Brady.

Subfamily PENEROPLIDINÆ.

10. Cornuspira carinata Costa.
11. C. involvens Reuss.

Family ASTRORHIZIDÆ.

Subfamily RHABDAMMININÆ.

12. Marsipella cylindrica Brady.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

13. Textularia concava Karrer.
14. T. quadrilateralis Schwager.
15. Spiroplecta americana Ehrenb.

Subfamily BULIMININÆ.

16. Bulimina aculeata d'Orb.
17. Virgulina subsquamosa Egger.
18. Bolivina punctata d'Orb.

Subfamily CASSIDULININÆ.

19. Cassidulina crassa d'Orb.

Family CHEILOSTOMELLIDÆ.

20. Cheilostomella ovoidea Reuss.
21. Allomorphina trigonula Reuss.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

22. Lagena sulcata W. & J.
23. L. sulcata var. interrupta Williamson (apiculate and non-apiculate forms).
24. L. hispida Reuss.
25. L. striata d'Orb.
26. L. orbignyana Seg.
27. L. globosa Montagu, var. grandipora, var. n. (Plate vi., fig. 10).

Subfamily NODOSARIINÆ.

28. Nodosaria communis d'Orb.
29. N. costulata Reuss.
30. N. inflexa Reuss.
31. N. scalaris Batsch (apiculate and nonapiculate, striated and nonstriated forms).
32. N. simplex Silv.
33. Lingulina carinata d'Orb.
34. Cristellaria sp.
35. C. calcar Linn. (nonspinous variety).
36. C. variabilis Reuss.
37. Cristellaria sp.; a young form intermediate between *C. crepidula* and *C. tricarinella*.
38. Cristellaria haswelli Goddard, Records of the Australian Museum, Vol. vi., Part 4.
39. Vaginulina sp.
40. Rhabdogonium tricarinatum d'Orb.

Subfamily POLYMORPHININÆ.

41. Uvigerina canariensis d'Orb.
42. U. interrupta Brady.
43. U. schwageri Brady.

44. SAGRINA COLUMELLARIS Brady.
45. S. SYDNEYENSIS, nov.sp. (Plate vi., figs. 4*a*, *b*, *c*).

Family GLOBIGERINIDÆ.

46. GLOBIGERINA BULLOIDES d'Orb.
47. G. BULLOIDES var. TRILOBA Reuss.
48. G. DUBIA Egger.
49. G. ÆQUILATERALIS Brady.
50. G. SACCULIFERA Brady.
51. ORBULINA UNIVERSA d'Orb.
52. O. POROSA Terq.
53. PULLENIA OBLIQUILOCULATA P. & J.
54. HASTIGERINA PELAGICA d'Orb.

Family ROTALIIDÆ.

Subfamily SPIRILLININÆ.

55. SPIRILLINA VIVIPARA Ehrenb.

Subfamily ROTALIINÆ.

56. DISCORBINA ARAUCANA d'Orb.
57. D. BERTHELOTI d'Orb.
58. D. BICONCAVA P. & J.
59. D. ORBICULARIS Terq.
60. D. PARISIENSIS d'Orb.
61. D. SAULCII d'Orb.
62. D. VALVULATA d'Orb.
63. D. VILARDEBOANA d'Orb.
64. TRUNCATULINA HAIDINGERII d'Orb.
65. T. PRÆCINCTA Karrer.
66. T. WUELLERSTORFII Schwager.
67. T. TENUIMARGO Brady.
68. ANOMALINA ARIMINENSIS d'Orb.
69. A. AMMONOIDES Reuss.
70. A. GROSSERUGOSA Gümb.
71. PULVINULINA HAUERI d'Orb.
72. P. MENARDII d'Orb.

73. P. MICHELINIANA d'Orb.
74. P. PAUPERATA P. & J.
75. P. PROCERA Brady.
76. P. CANARIENSIS d'Orb.
77. P. CRASSA d'Orb.
78. P. EXIGUA Brady.
79. ROTALIA PAPILLOSA Brady, var. COMPRESSIUSCULA Brady, C.R. pl.cviii.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

80. NONIONINA BOUEANA Reuss.
81. N. DEPRESSULA W. & J.
82. N. POMPILIOIDES F. & M.
83. N. SCAPHA F. & M.

SAGRINA SYDNEYENSIS, n.sp. (Plate vi., figs.4*a*, *b*).

This species has a straight cylindrical test. The commencement is a large hemispherical chamber which, however, contains one septum, indicating a uvigerine commencement. The subsequent chambers are short and cylindrical, and do not at first increase in diameter. Subsequently they increase slowly in diameter as well as in length (fig.4*a*). The surface of each chamber is ornamented with minute spines, and two or three extraordinarily large oval pores. The latter are irregularly distributed, but are chiefly found towards the proximal end of each segment. Size: length 0·57 mm.

CERVICIFERINA HILLI gen. et sp.nov. (Plate vi., figs.7*a*, *b*).

This remarkable form is circular in outline, and very depressed, nevertheless slightly biconvex, and surrounded by an equatorial keel (fig.7*a*). The initial chamber in the specimen figured is distinctly oval in outline and has an entosolenian neck. The succeeding chamber envelops the one first formed, and is distinctly flask-shaped. After this the chambers become more and more rounded, and the distal end of the one chamber is at the

f the next (see fig.7*a*). The shell is porcellanous e. It is surrounded by a keel having a peculiar dage.

most closely allied to the genera *Ophthalmidium* from which it is distinguished by the characteristic s that the chambers have no trace of spiral com- t are arranged in an alternating manner, and possesses a well marked neck. Diam. 0·38 mm.

RIA VARIABILIS Reuss, var. (Plate vi., fig.8).

igured is sufficiently near the type to be assigned The figure shows the irregular arrangement of nd the possession of a keel.

p., intermediate between *C. lata* and *C. crepidula* (Fichtel & Moll). (Plate vi., fig.9).

n is a very flattened minute form which has the f chambers of *C. crepidula* (Challenger Report,

RIA HASWELLI Goddard, var. (Plate vi., fig.6).

closely approaches *C. Haswelli* in general contour, gement of the chambers that there seems no ve it a separate varietal name. As varietal dis- en this form and the type, we might mention that shows but the faintest trace of a recurving; also pheral margin of the shell has a wavy contour n outline of the type. The shell is also broader ype-form (Records of the Australian Museum, .).

GLOBOSA Montagu, var. GRANDIPORA, var.nov. (Plate vi., fig.10).

as the entosolenian neck and ovoid shape of *L.* ffers only from the type in possessing a number egularly distributed large pores.

epresented in this list overlap to a great extent by H.M.C.S. "Miner" 22 miles east of Sydney

Heads, at a depth of 80 fathoms, and described by one of u
(E. J. G.) in the Records of the Australian Museum (Vol. vi
Part iv.). They also show considerable affinity to thos
dredged at a depth of 100 fathoms, 16 miles east of Wollongong
The similarity is striking in connection with the *Globigerinidæ*
Discorbina and *Pulvinulina*, which are very abundant in all the
dredgings. The Wollongong material, however, differs from th
other materials in the abundance of arenaceous and semi
arenaceous foraminifera.

Truncatulina praecincta, which is characteristic of warm
waters and occurs on our coasts in all localities north of Sydney
is present in these dredgings, but is absent in the shallow
water off Wollongong. The differences between the materi
dredged off Wollongong and off Sydney Heads is probably to b
ascribed to the different nature of the bottom in the two place
Off Wollongong the bottom is largely basaltic, and off Sydn
it is sandstone.

In the Sydney Heads material about 70 % is foraminifera
Glauconitic casts are fairly abundant, but not to the same exte
as in the Wollongong material. The foreign material consists
fragments of gastropod shells, pteropod shells, ostracods, spicule
and polyzoa.

The Mollusca from 300 fathoms off Sydney Heads have bee
described by Mr. C. Hedley in the Records of the Australia
Museum (Vol. vi., Part 3).

4. *Foraminifera from Lyell Bay, New Zealand, collected on t
beach by Mr. A. Hamilton.*

The material consists chiefly of gastropod shells, lamellibranc
shells, polyzoa and coralline algæ. The following foraminifer
were noticed :—

Family ASTRORHIZIDÆ.

Subfamily **RHABDAMMININÆ.**

1. Brachysiphon corbuliformis Chapman, Trans. N. Z. Ins
xxxviii. 1905, pl. iii., figs 2*a*, 2*b*, 3.
2. Aschemonella catenata Norman.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

VESICULARIS Lamk.
d'Orb.
INA ROSEA d'Orb.; rare.

specimens of *Brachysiphon corbuliformis* and *atenata* were obtained. *Brachysiphon* is a new d by Chapman in his paper on the Foraminifera obtained off Great Barrier Island, New Zealand. *esicularis* is the most plentiful form.

ra obtained in shore (shell) sands at Kelso on the north coast of Tasmania.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

RINGENS Lamk.
d'Orb. var.
CIRCULARIS Bornem.
UM Linn.
IATA d'Orb.
LA Lamk.
W. & J., var.nov.

Family LAGENIDÆ.

Subfamily POLYMORPHININÆ.

INA ROTUNDATA Bornem.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

PARISIÈNSIS d'Orb. (Plate vi., fig.11).

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

ROSACEA d'Orb.
RIS Lamk.
A PROTEIFORMIS Goës.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

13. POLYSTOMELLA IMPERATRIX Brady.

This material was submitted to us by Miss M. Lodder. Accompanying the foraminifera there are several species of polyzoa.

The Miliolina which we have referred to *M. bicornis* is a new variety which has the striations and ornamentation of *M. pulchella* but the outline, aperture, and tooth of *M. bicornis*. The tooth, however, is rather more slender than that of typical *M. bicornis*.

Discorbina rosacea and *D. vesicularis* are the most abundant forms in the material, and they attain greater dimensions and more perfect development than those found in the Lyell Bay material, and other foraminiferal sands which we have examined.

It might be remarked that *Discorbina vesicularis* appears to thrive best in shallow water of the south temperate zone, especially where the waters are cold, as in Bass Strait where we have the Antarctic drift entering from the south-west.

Although specimens of this species occur in Port Jackson, they do not attain the grand development which they exhibit in Bass Strait. No doubt it will be found in increasing abundance south of Sydney, as we approach the cold current entering the Pacific Ocean through Bass Strait.

6. *Fossil Foraminifera kindly submitted by Miss M. Lodder, of the Launceston Museum.*

This material was obtained from the débris of fossil mollusca collected at Table Cape.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. BILOCULINA SPHÆRA d'Orb.
2. B. IRREGULARIS d'Orb.
3. B. ELONGATA d'Orb.
4. B. RINGENS Lamk.

ALVEOLINIFORMIS Brady.
ENTA Brady.
RIS Bornem.
OII d'Orb.
NA d'Orb.; only one specimen with small neck.
IANA Brady.
NS Brady.
LUM Linn.
ULA Lamk.
INATA d'Orb.
LINA LIMBATA d'Orb.
RGO Brady.
SSIMA Brady.
PTATA Brady.
Czjzek.
ARUM d'Orb.
d'Orb.
ATA Lamk.

Subfamily **HAUERININÆ**.

RINA CELATA Costa.
RIA d'Orb.
A Brady.
ILINA) SIGMOIDEA Brady.
MIDIUM INCONSTANS Brady.

Subfamily **PENEROPLIDINÆ**.

RA CARINATA Costa.
EA Phil.
VENS Reuss.

Family ASTRORHIZIDÆ.

Subfamily **ASTRORHIZINÆ**.

IZA CRASSATINA Brady.

Subfamily **RHABDAMMININÆ**.

MMINA SUBNODOSA Brady.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

33. Reophax scorpiurus Montf.
34. R. lodderæ, n.sp.
35. Haplophragmium emaciatum Brady.
36. H. meridionale Chapman. (Plate vi., fig. 12).

Subfamily TROCHAMMININÆ.

37. Thurammina compressa Brady (?).
38. T. papillata Brady.

Subfamily LOFTUSIINÆ.

39. Cyclammina (?) cancellata (?) Brady.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

40. Textularia sp.

Subfamily BULIMININÆ.

41. Bulimina pyrula d'Orb.
42. Virgulina subsquamosa Egger.

Subfamily CASSIDULININÆ.

43. Cassidulina subglobosa Brady.
44. C. parkeriana Brady.

Family CHEILOSTOMELLIDÆ.

45. Cheilostomella ovoidea Reuss.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

46. Lagena sulcata W. & J.
47. L. aspera Reuss.
48. L. favosopunctata Brady.
49. L. trigonomarginata P. & J.
50. Lagena sp.

Subfamily NODOSARIINÆ.

51. Nodosaria roemeri Neugeb.
52. N. soluta Reuss.

Reuss, var. SEMICOSTATA, n.var. (Plate vi., fig. 14).
IIS d'Orb.
Linn.
IIUM TRICARINATUM d'Orb.
ARIA TRIMORPHA, n.sp. (Plate vi., fig. 13).

Subfamily POLYMORPHININÆ.

INA ELEGANTISSIMA P. & J.
S d'Orb.
Reuss.
SA d'Orb.
TA Bornem.
ATA Reuss.
B.P. & J.
PHANUS P. & J.

Family GLOBIGERINIDÆ.

IA LINNÆANA d'Orb.
A d'Orb.
UNIVERSA d'Orb.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

TURBO d'Orb.
LOTI d'Orb.
ARIS d'Orb.
NSIS d'Orb.
d'Orb.
BOANA d'Orb.
INA HAIDINGERII d'Orb.
A W. & J.
ENS Montf.
A Brady.
'Orb.
NA d'Orb.
RSTORFII Schwag.

82. ANOMALINA AMMONOIDES Reuss.
83. A. GROSSERUGOSA Gümb.
84. PLANORBULINA LARVATA P. & J.
85. P. ACERVALIS Brady.
86. PULVINULINA CARPENTERI Reuss (Chapman, Journ. Roy. Micr. Soc. 1898, p.8, pl. i., figs.11*a-c*).
87. P. ELEGANS d'Orb.
88. P. FAVUS Brady.
89. P. MENARDII d'Orb.
90. P. CANARIENSIS d'Orb.
91. P. TUMIDA Brady.
92. CYMBALOPORA (?) POEYI d'Orb. (?)
93. ROTALIA BECCARII Linn.
94. R. ORBICULARIS d'Orb.
95. R. SOLDANII d'Orb.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

96. NONIONINA BOUEANA d'Orb.
97. N. POMPILIOIDES F. & M.
98. N. DEPRESSULA W. & J.
99. POLYSTOMELLA CRATICULATA F. & M.
100. P. MACELLA F. & M.
101. P. STRIATOPUNCTATA F. & M.
102. P. SUBNODOSA Münst.
103. P. VERRICULATA Brady.

Subfamily CYCLOCLYPEINÆ.

104. CYCLOCLYPEUS sp.

New Species and Varieties.

HAPLOPHRAGMIUM MERIDIONALE (?) Chapman, var.

Only one specimen of this species was obtained. The test was thin, diaphanous and subelliptical, but the sutures were not well marked. We refer it to Mr. Chapman's new species on account of its resemblance to the shell figured by him in Ann. S. Afr. Mus. Vol. iv., pl. xxix., fig.2.

FRONDICULARIA TRIMORPHA, n.sp. (Plate vi., fig.13).

This species, as shown in fig.13, has the earlier chambers arranged as in the genus *Cristellaria*; three or four chambers arranged as in *Frondicularia inæqualis* follow, and the final chambers are irregularly disposed as in *Polymorphina*. Size: length 1·38 mm.

NODOSARIA ROEMERI Neugeboren, var. SEMICOSTATA, var.nov. (Plate vi., fig.14).

This varietal form has the shape, size, and aperture of the type, but the earlier chambers bear well marked longitudinal costæ which have a tendency to run spirally round the shell. This character links the variety to *Nodosaria prismatica* (Reuss). Size; length 4 mm.

REOPHAX LODDERÆ, sp.n. (Plate vi., fig.15).

This is a large form consisting of a linear series of chambers whose tests are composed of sand grains and spicules. The spicules are large, derived from echinoids, and are placed with the greatest regularity, one row corresponding to each chamber of the test, and overlapping the row belonging to the next chamber. Length (incomplete); diameter 0·75 mm.

The Table Cape material was forwarded to one of us (H. I. J.) by Miss M. Lodder, an Associate Member of this Society, and Honorary Curator of the Launceston Museum. She has very kindly also supplied us with particulars how the material was collected. She writes as follows:—"I collected the specimens (foraminifera) from the débris of the matrix (molluscan shells), as well as from the inside of a large number of shells collected by various people from the Tertiary beds at Table Cape." The mollusca include Terebra, Voluta, Bela, Ancilla, Marginella, Typhis, Murex, Cypræa, Natica, Lima, Pecten, Arca, Cucullæa, Glycimeris, Cardita, Crassatellites, Chione, Solenocurtius, Tellina, &c.

Miss Lodder believes that most of the above fossils were taken from the sea-side, or broken face, of Table Cape.

In response to an enquiry made by the authors as to the supposed age of the beds from which the fossils were taken, Miss Lodder has kindly furnished the following information:—"I can only quote the words of Mr. J. Dennant and Mr. A. E. Kitson in their Catalogue of the 'Described Species of Fossils (except Bryozoa and Foraminifera) in the Cainozoic Fauna of Victoria, S. Australia, and Tasmania,' published in the Records of the Geological Survey of Victoria (Vol. i. pt. 2, 1903, p. 189).

"'Group C. records the fossils belonging to the Table Cape and Spring Creek Deposits. By Tate they have been named Post-Eocene (Oligocene?), while by Messrs. Hall and Pritchard they are placed on a lower horizon than the distinctly Eocene Mornington Beds. Their separate grouping in this catalogue of species is intended to imply that no opinion is expressed concerning the relative age of the beds in question. Those interested in the matter should consult original memoirs.'"

In the Proceedings of the Royal Society of Victoria, Vol. viii. (New Series) Mr. G. B. Pritchard publishes "A Revision of the Fossil Fauna of the Table Cape Beds, Tasmania, with Descriptions of New Species." His inferences regarding the age of the beds are almost identical with our conclusions from a study of the Foraminifera.

The Foraminifera contained in the Table Bay material have a decidedly Eocene or Palæogene character, agreeing closely with those enumerated for the Eocene by Howchin.*

The occurrence of forms answering to the description of *Pulvinulina carpenteri* and *Haplophragmium meridionale* figured by Chapman in his account of the foraminifera of Pondoland West† serves as corroborative evidence of the old-Tertiary age of the material.

Nodosaria zippei and *Rotalia soldanii* occur here as well as in Mr. Chapman's Pondoland material which, however, is Cretaceous.

* Report Aust. Assoc. Adv. Sc. Vol. v. Adelaide, S.A., 1893.
† Ann. South African Mus. Vol. iv. Part v.

ostracods having the appearance of forms figured
n the above-mentioned report were observed in the

it may be stated that the richness of the foramini-
indicative of warm water conditions of deposition.
certain that the material was laid down at a depth
150 fathoms. These conclusions are based on the
forms which are restricted to warm zones and
, and to the complete absence of cold-water forms
bina vesicularis which now flourishes in the same

lose correspondence between the Miliolidæ of the
ossil material and recent dredgings from Sydney
3yron Bay. The Table Cape fossil Nodosariinæ
sely with Howchin's Eocene list and those occurring
y. The abundance of Polymorphininæ indicates
shallow water (less than 200 fathoms). The
Polystomellinæ, and especially so of species which
t Sydney or Byron Bay now, but are restricted to
al waters, as at Torres Strait and the Barrier Reef,
sive evidence of warm-water conditions at the time

cies found in the Table Cape fossil material deserve
n in support of these statements; they are:—
na irregularis is a tropical species, which has only
by us elsewhere in the Gulf of Carpentaria material.
a alveoliniformis is a coral-reef species confined to
. Occurs also in the Gulf of Carpentaria.
a rupertiana occurs only in shallow water in warm

ulina antillarum is a common form off the coast of

ulina planulata and *S. nitida* are closely allied
rmer being characteristic of temperate zones, the
g it in the tropical zone. Both are shallow water
th occur at Table Cape.

[The Miliolidæ in general flourish best in tropical seas, from the shore to depths of 150 fathoms; and this family is exceedingly well represented].

(f) *Cassidulina parkeriana* is characteristic of tropical seas at depths of 45-175 fathoms.

(g) *Lagena favosopunctata* is, according to the Challenger Report, restricted to the shores of New Guinea and Torres Strait at a depth of 17 to 155 fathoms.

(h) *Polymorphina regina* is a shallow water form occurring round the islands of the Pacific, to be found in Howchin's list of Eocene foraminifera, but not in later Tertiary Australian deposits.

(i) The Rotaliidæ of our Table Cape material exhibit a striking parallelism to the forms now occurring off Sydney Heads and Byron Bay, especially as regards Truncatulina. Discorbina is not an abundant form, and the species present are forms which thrive best in warm latitudes.

From a study of this material, the conclusion is unavoidable that the material was deposited in Eocene times in a shallow sea; and, furthermore, that in this period climatic conditions were much warmer in the Tasman region than now.

In conclusion it is necessary to mention that our attention has been drawn by Mr. F. Chapman, F.R.M.S., to the fact that recent forms resembling *Biloculina ringens* and *B. bulloides* are referred to other genera on account of their internal structure differing from the fossil forms for which the above-mentioned names have been retained.* We have however not sectioned any of the forms of Miliolidæ enumerated in our lists, and have therefore retained the well-known names of *Biloculina ringens* and *B bulloides;* the retention of these names in our paper has the advantage of making these lists consistent with other lists of Australian Foraminifera such as Whitelegge's list in "Invertebrate Fauna of Port Jackson and Neighbourhood," †

* Schlumberger, Mém. Soc. Zool. France. Vol. iv. 1891.

† Journ. Proc. Roy. Soc. N.S. Wales. Vol.xxiii. 1889.

Howchin's "Census of the Fossil Foraminifera of Australia,"* and our own previously published notes, as well as with the Challenger Report and Flint's "Recent Foraminifera."

We are also indebted to Mr. F. Chapman for pointing out to one of us that *Miliolina bucculenta* in this and in our previous papers should read *Planispirina bucculenta*. *Biloculina sphæra* d'Orbigny, should likewise read *Planispirina sphæra*; and *Planispirina sigmoidea* should read *Sigmoilina sigmoidea*. We retain the commoner names for the sake of consistency and because we have not had access to the papers in which the proposed changes and the reasons for them are given.

In his "Notes on Prosobranchiata No. i.,"† discussing Australian fossil species of the genus Lotorium, Mr. H. L. Kesteven remarks:—"*Lotorium parkinsonianum* is the recent representative of *L. radiale*, *abbotti*, *textile*, *woodsii*, and *tortirostris*." A glance at Dennant's "Catalogue of the Described Species of Fossils,"‡ shows that three of these species, namely, *Lotorium (Lampusia) abbotti*, *woodsii*, and *tortirostris* occur at Table Cape. On p. 455 of the same paper Mr. Kesteven goes on to say:—"Thus, if we compare this genus (Lotorium) as it occurs in the Lower Australian strata with European Miocene representatives, we are presented with two entirely different types of the genus. The predominating feature of the Australian section—that of the extinct Antarctic group—finds expression in only one European fossil (*L. tarbellianum*). Again, if the two groups be compared with the recent representatives it will be seen that the European section has the general facies of recent species, whilst the Australian fossils can, with one exception, be only compared *inter se*. . . . . These facts . . . . assuredly point to the greater antiquity of the Australian fossils."

From the large number of specimens which had their apices complete (over 70 per cent.) Mr. Kesteven infers (*op. cit.* p. 465) that the beds were deposited below the tidal limit.

* Report Aust. Assoc. Adv. Sc. Vol. v. Adelaide, 1893.

† Proc. Linn. Soc. N.S.Wales, 1902, p. 454.

‡ Records Geol. Surv. Victoria, Vol. i, Part 2, p. 107.

It is very interesting to notice that our conclusions as regards the age of the deposits, and the depth at which they were laid down, agree so closely with those of Mr. Kesteven based on a study of the mollusca.

EXPLANATION OF PLATE VI.

Fig. 1.—*Textularia quadrilatera* var. (× 90).
Fig. 2.—*Cristellaria variabilis* var. *allomorphinoides*, n. var. (× 90).
Fig. 3*a*.—*Sagrina australiensis* n. sp. (× 90).
Fig. 3*b*.—*Sagrina australiensis*, n. sp., showing appearance by transmitted light under higher power.
Fig. 3*c*.—*Sagrina australiensis*, n. sp., showing tubules in walls.
Fig. 4.—*Sagrina sydneyensis*, n. sp. (× 90).
Fig. 4*b*.—*Sagrina sydneyensis*, n. sp., showing pores and structure of wall.
Fig. 5*a*.—*Articulina chapmani*, n. sp. (× 90).
Fig. 5*b*.—*Articulina chapmani*, n. sp., showing ornamentation under higher power.
Fig. 6.—*Cristellaria haswelli* var. (× 90).
Fig. 7*a*.—*Cerviciferina hilli*, n. sp.; seen by reflected light (× 90).
Fig. 7*b*.—*Cerviciferina hilli*, n. sp.; seen by transmitted light (× 90).
Fig. 8.—*Cristellaria variabilis* var. (× 90).
Fig. 9.—*Cristellaria* sp., intermediate between *C. lata* and *C. crepidula* (× 90).
Fig. 10.—*Lagena globosa* var. *grandipora*, n. var. (× 90).
Fig. 11.—*Clavulina parisiensis* (× 30).
Fig. 12.—*Haplophragmium meridionale* var. (× 30).
Fig. 13.—*Frondicularia trimorpha*, n. sp.; seen by transmitted light (× 30).
Fig. 14.—*Nodosaria roemeri* var. *costata*, n. var. (× 30).
Fig. 15.—*Reophax lodderae*, n. sp. (× 30).

THURSDAY, MAY 23RD, 1907.

SPECIAL GENERAL MEETING.

A Special General Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Thursday evening, May 23rd, 1907, to mark the occasion of the Bicentenary of Carl von Linné (1707-1778).

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

The President offered a hearty welcome to the guests of the evening—Count Birger Mörner, Consul for Sweden; President David Starr Jordan, of the Leland Stanford University; Mr. L. W. Marcker, Consul for Denmark; Mr. P. Board, M.A., Under-Secretary for Public Instruction; Mr. Alexander Mackie, M.A., Director of the Training College; Mr. Henry Deane, M.A., F.L.S., &c., President, and Mr. F. B. Guthrie, F.C.S., Hon. Secretary of the Royal Society of New South Wales; Mr. J. H. Maiden, F.L.S., &c., President of the Historical Society of New South Wales.

PROGRAMME.

Introductory Remarks by the President,
Mr. A. H. S. LUCAS, M.A., B.Sc.

The Invitations received from the Royal University of Upsala and the Royal Swedish Academy, Stockholm, and the Replies thereto.

SOCIETATI LINNAENANAE
quae in urbe Sydney est
S.P.D.
UNIVERSITAS REGIA UPSALIENSIS.

Praeterierunt hoc anno duo saecula, postquam natus est
CAROLUS LINNAEUS,
decus illud Universitatis Upsaliensis et totius patriae nostrae. Consentaneum est hoc potissimum tempore grato animo nos ea recordari, quae vir ille ad arcana naturae revelanda et maxime quidem ad botanices scientiam adaugendam atque promovendam felici labore

perpetravit, eamque ob rem in animo habemus diebus xxiii et xxiv mensis Maii huius anni memoriam natalis clarissimi viri ea, qua par est, pietate renovare atque celebrare. Spes autem est fore, ut Vos, Viri Doctissimi et Illustrissimi, hoc consilium nostrum benigne approbetis et sollemnibus, quae instituere decrevimus, interesse velitis. Itaque rogamus, ut unum aliquem ex Vestro numero legetis, qui hospitio nostro usus festos illos dies nobiscum agat. Quem legaveritis, ante Idus Martias, si placet, rescribite.

Valete et nobis favete.

Dabamus Upsaliae die x m. Januarii a. 1907.

SENATUS ACADEMICI nomine
HENRIK SCHÜCK.
Universitatis Upsaliensis h.t. Rector.

JOHAN v. BAHR,
Univ. Upsal. Secretarius.

(Reply).

SOCIETAS LINNEANA
in Nova Cambria Constituta
REGIAE UNIVERSITATI UPSALENSI
S.P.D.

Perbenigne fecistis, viri spectatissimi, quod natalem Caroli Linnaei ducentesimum celebraturi Societatem nostram quamvis longo locorum intervallo divisam ut legatum mittat invitastis. Cuius Societatis sedes haud iniuria videtur esse collocata in urbe totius Australiae vetustissima prope ipsum locum ubi primum comites illi Jacobi Cook, Banksius et Solander, quorum hic Linnaei discipulus fuerat, cum animantes novos tum eas res quas nova nostra terra gignit aspexere. Hic igitur, quasi in ipsis ut gentis ita scientiae nostrae cunabulis, obscura naturae loca illa illustrare luce conamur quam princeps Linnaeus vester mortalium animo effudit. Cui studio intentis quod cum nobis vestrorum fructus studiorum communicare soletis, gratias vobis et agimus et habemus maximas.

Legavimus autem Socium nostrum Jacobum Petrum Hill, in Collegio Londinensi Universitati Affini Zoologiae Professorem, qui vobis sollemnia ex pio animo gratuletur.

Dabamus Sydneiae die xiv. mensis Aprilis anni MCMVII.

ARTURUS H. S. LUCAS,
Praeses.

JOSEPHUS J. FLETCHER,
Secretarius.

EGIA ACADEMIA SCIENTIARUM SUECICA
SOCIETATI LINNEANAE,
quae in urbe Sydney est,
S.P.D.

huius anni duo secula erunt, postquam homen illud

CAROLUS LINNAEUS

gressus. Cuius nomen cum universae patriae illus-iae sit, tum Academiae nostrae praecipue celebrandum e eius studio atque operae originem suam magnam Itaque constituimus natalem eius bisecularem, quo prosequi.

abeatur, opus erit adesse, si non corporibus, at certe os, qui, Linnaeus quid contulerit ad rerum naturalium iendam, penitus perspexerint eiusque memoriam pie ille quidem civis noster, sed idem universo generi e floribus totius orbis terrarum sedulae apis modo uid posset rerum naturae ordinem habitumque in-cem afferre. Et est certe inter eos, qui ubique que operam dant, societas quaedam studiorum, quae a eos impediri non sinit, quominus coniunctis viribus eademque promoveant. Quod cum ita sit, speramus am nobis Linnaei memoriam celebraturis mente ac is atque, si modo fieri poterit, unum aliquem e Vestro , qui coram adsit sollennibus nataliciis, quae agentur xv Maii, rogamusque velitis ante Kalendas Apriles eras communicare, quem adlegaveritis.

ie favete.

niae die I m. Februarii a. 1907.

ACADEMIAE SCIENTIARUM nomine
PETER KLASON
Academiae scient. h. t. Praeses.

CHR AURIVILLIUS
Secretarius perpetuus.

(Reply).

SOCIETAS LINNAEANA
quae in Urbe Sydneia est
IAE ACADEMIAE SCIENTIARUM SUECICAE
S.P.D.

o, viri ornatissimi, accepimus litteras vestras, quibus alem Caroli Linnaei ducentesimum coram celebremus uistis, quippe quae cum sanctum illud communium

studiorum vinculum quo, quamvis longo spatiorum intervallo divisi, cum cultis veteris orbis gentibus simus coniuncti, tum communem nostram divini illius hominis venerationem testificentur.

Nos quidem nostram debemus originem Alexandro Macleay, homini vere Linnaeano, Academiae vestrae Socio, per annos septem et viginti Societatis Linnaeanae apud Londinenses Secretario, qui, cum anno demum MDCCCXXV. huc advenisset, semina sparsit eorum studiorum quae nos praecipue colimus, quaeque iam per totam Australiam florent. Quorum studiorum fructus cum Linnaeo vestro, qui primus veras naturae animantis rationes per orbem terrarum propagavit, iure referamus acceptos, dies festos, quos in maiorem illius gloriam celebraturi estis, faustis omnibus pio gratoque animo prosequemur.

Legavimus autem Socium nostrum Jacobum Petrum Hill, in Collegio Londinensi Universitati Affini Zoologiae Professorem, qui feriarum sit particeps et nostris suique verbis bona omnia vobis comprecetur.

Dabamus Sydneiae,
Id. Apr. MCMVII.

ARTURUS H. S. LUCAS,
Praeses.

JOSEPHUS J. FLETCHER,
Secretarius.

ADDRESSES.

The Predecessors of Linnæus - - -	THE PRESIDENT.
The Personal History of Linnæus -	Mr. H. I. JENSEN, B.Sc.
Linnæus, the Man of Science	Professor HASWELL, D.Sc., F.L.S., F.R.S.; Mr. J. H. MAIDEN, F.L.S.
The 'Systema Naturæ,' &c. - -	Mr. C. HEDLEY, F.L.S.
The Contemporaries of Linnæus - -	Professor WILSON, M.B., Ch.M.
The immediate Successors of Linnæus	THE SECRETARY.; Dr. H. G. CHAPMAN.
Sir J. E. Smith and the Linnean Society of London, as, "in a sense, the heirs of Linnæus" (*Fries*) - - -	Mr. HENRY DEANE, M.A., F.L.S., &c.
The Linnean Society of New South Wales—the choice and significance of the name - -	Prof. DAVID, B.A., F.G.S., F.R.S.
Concluding Remarks - - -	By the PRESIDENT.
Address - - - -	By the CONSUL FOR SWEDEN.

Professor Jordan, who arrived in Sydney after the details of the programme had been settled and printed off, very kindly acceded to the President's invitation to address the Meeting.

VEDNESDAY, MAY 30TH, 1907.

RDINARY MONTHLY MEETING.

ry Monthly Meeting of the Society was held in Hall, Ithaca Road, Elizabeth Bay, on Wednesday 30th, 1907.

. Lucas, M.A., B.Sc., President, in the Chair.

OMAS HARVEY JOHNSTON, M.A., B.Sc., Technical ey; ROBERT KALESKI, Liverpool, N. S. W.; ACKIE, M.A., Director of the Training College, 'RANK H. TAYLOR, Technological Museum, Sydney, rdinary Members of the Society.

nt announced that, under the provisions of Rule cil had elected Mr. HENRY DEANE, M.A., F.L.S., &c., DEN, F.L.S., &c., Dr. T. STORIE DIXSON, and Mr. , F.C.S., F.L.S., &c., to be VICE-PRESIDENTS; and LAND, M.A. (Bull's Chambers, 14 Moore Street) to urer, for the current Session.

letter from Count Mörner, Consul for Sweden, Society for its tribute to the memory of Carl von the opportunity of attending the Special Meeting mmemorate the Bicentenary; and also expressive which it had afforded him, as the representative nd of Linné, to take part in the proceedings, was Chair.

on from the New York Academy of Science to ts celebration of the Bicentenary of Carl von Linné d. The letter unfortunately did not arrive until

on to Members to attend a Meeting of the Sydney Society of Chemical Industry on 12th June, at . G. Smith, F.C.S., &c., will contribute a paper

"On recent work on the Eucalypts and what it teaches," was communicated.

The President, in referring to the recent death of Mr. Alexander Morton, Secretary of the Royal Society of Tasmania and Curator of the Hobart Museum, said that everyone who had attended the Meetings of the Australasian Association in Hobart, who had had occasion to consult the collections in the Hobart Museum, or was otherwise interested in the flora or fauna of Tasmania, had had opportunities of appreciating Mr. Morton's kindness, his freely rendered help, and his capacity for organising arrangements for the benefit of visiting naturalists.

Professor David spoke in support of the President's testimony; and, upon his motion, it was resolved that a letter of sympathy be sent to Mrs. Morton.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 5 Vols, 80 Parts or Nos., 48 Bulletins, 2 Reports, and 3 Pamphlets, received from 58 Societies, &c., and 2 Individuals, were laid upon the table.

The President invited discussion upon the papers by Messrs. E. C. Andrews, T. G. Taylor, Dr. W. G. Woolnough, and Mr. G. H. Halligan in Parts 3 and 4 of the Proceedings for 1906, recently published. As there was much to be said in the time available, the discussion resolved itself chiefly into criticism of the theoretical considerations brought forward in Mr. Andrews' paper entitled "The New Zealand Sound (and Lake) Basins and the Cañons of Eastern Australia in their bearing on the Theory of the Peneplain," and in Mr. Halligan's paper "On Sand-Movement on the New South Wales Coast." Dr. Woolnough opened the discussion, and Messrs. J. E. Carne, G. H. Halligan, the President, and Mr. Andrews took part.

THE LAKE GEORGE SENKUNGSFELD, A STUDY OF THE EVOLUTION OF LAKES GEORGE AND BATHURST, N.S.W.

By T. Griffith Taylor, B.Sc., B.E., Assistant Demonstrator in Geology and Lecturer in Commercial Geography at the University of Sydney.

(Plates vii.-x.)

CONTENTS.

Part i. Lake George.

i. Introduction.

The lakes of New South Wales are conspicuous by their rarity. Undoubtedly the most important, and perhaps the largest, is Lake George, which lies in the angle between the Southern and Cooma railway lines. It is 25 miles south-west of Goulburn, but is most accessible from Bungendore, on the Cooma line. With the exception of the meteorological investigations instituted

by the late Mr. H. C. Russell, little research—certainly none of a physiographic nature—has been carried out in this district.

The following statement embodies the current opinion as to the lake's environment, and is in itself sufficient to indicate a very promising field of research on the lines of modern physiography. The quotation runs as follows:—"Lake George occupies . . . . the southern portion of a depression in the Cullarin Range, called the Lake George Basin, 490 square miles in extent, and (is) *the solitary example in the colony of a purely inland drainage area*, watered as it is by several small streams, but having no visible outlet."*

Paradoxical as it may sound, a lake is to a certain extent an *unnatural* natural feature. At any rate, especially in mountainous regions, its presence often implies abnormal conditions. Thus the great lakes of America are due to the somewhat erratic arrangement of the drifts of the Ice Age. The great lakes of Africa are due to a huge crustal rift. The small lakes of Kosciusko are geologically ephemeral, and the moraine barriers which dam back the waters are rapidly vanishing as the streams *cut down to base level*, which is indeed their "aim in life." Any complete interruption of a large drainage area, such as obtains in the case of the Lake George Basin, points to important late geological changes; which changes will, it is hoped, be clearly demonstrated in the succeeding account of the Lake George Senkungsfeld (*subsidence area*).

ii. General Topography.

A reference to the stereogram (Plate viii.) will convey a clear idea of the topography of Lake George. The lake proper extends about 15 miles in a north and south direction, and may be closely compared in outline to a *bow* (variety Cupid's); the string symbolising the *straight, even* western shore, while the double-curved eastern boundary resembles the wooden bow. This contrast of

* Geography of New South Wales, 3rd Ed., by J. M. Taylor, p.81. (The italics are mine. —T.G.T.).

f great importance in the physiography of the lake,
ove analogy will perhaps be found of assistance.
thern extremity a series of gravel banks separate
Murray's Lagoon, which latter at present (February,
area about one mile in diameter covered thickly
Beyond this the country consists of a flat expanse
ards Breadalbane. The Divide between the Wollon-
stem and the Lake George area is not well defined
lie just north of the main Southern Railway.
tern shore the lake outline is somewhat irregular.
nt, Rocky Point, Currandooley Point and Native Dog
rs projecting from the Gourock Range into the lake
In broad valleys between these spurs lie the streams
Lake George; Murray's Creek (the name on the map,
ya, one is not surprised to find unknown in the
lor's Creek at the foot of Governor's Hill, the most
dmark round Lake George; Deep Creek and Turallo
ill be noticed that these creeks converge on the
n as Geary's Gap (*vide* stereogram).
to the western shore, we are struck by the absolute
Standing at the level of the lake we seem to be
a giant wall extending northwards for over twenty
e Molonglo Plain. No broad valley breaks its con-
eed, to one cycling along the foot of the Cullarin
ms unbroken by any definite gap, while for a large
nts a steep face 500 feet high to the lake. From
hore (Governor's Hill), however, one is able to see
l *gap* about half-way along the western shore where
ern Road crossed the Cullarin Range. This depres-
Gap—was well known in the days before the rail-
ow practically unused by travellers. Less than two
f Geary's Gap a stream (Grove Creek) rushes down
Contrast its course with that of Taylor's Creek on
shore. The latter stream flows through a broad
or two wide, scooped out of the granite, and shows
le of a mature or senile type of river. The Grove

Creek is barely a mile long, yet descends nearly three hundred feet. Its course is interrupted by falls 25 feet high, and finally it emerges from a gorge, or miniature cañon, with steep sides 200 feet high. Evidently it is a stream which has barely reached the youthful stage. The hollows carved out of the slate bear witness to the violence of the stream upon occasions, but for the greater part of the year it dwindles to a succession of rocky pools.

Travelling south, we arrive at a stream of some importance, the Molonglo River, about 12 miles south of the lake. This cuts across the Cullarin Range near Hoskin's Town (see Plate vii.). Suspecting that this river might have participated in the abnormalities characteristic of the Lake George Basin, I wrote to Mr. A. E. Tuckwell, of Hoskin's Town, who amply confirmed my anticipations, as the following extract will show:—"The Molonglo River *leaves the flat country* 5 miles to the west of Hoskin's Town Public School, and flows through *a narrow gorge* bounded by hills, some of them approaching mountains."

Anyone who has enjoyed a trip up the Nepean from Penrith to Mulgoa, will remember that, at the latter place, the river leaves the plains and abruptly enters a steep gorge. The Nepean Gorge is due to the river *gradually eating down* its bed as the Blue Mountain scarp was elevated. This is the key to the Lake George problem. The Molonglo River (see Plate viii., at the lower rim of the model) has kept to its bed in spite of the fact that its basin at one period of its existence experienced a differential movement, the upstream portion sinking with respect to the lower. Subsequently (28th March, 1907) I visited the Molonglo Water-Gap and found that the river's course is concordant with the above account. Immediately at the entrance of the gorge, the slates and laminated quartzites are much crumpled and overfolded. This is the only locality where I observed such phenomena; the Silurian (?) strata, for the most part, being folded on a *large* scale and not crumpled locally. This local action occurring just at the plane where upthrow and downthrow meet, would seem to suggest that some considerable secondary folding has been superimposed on the ancient Silurian

anticlines. In fact here we may have positive e *Tertiary folding* into which the Cullarin or Lake has passed at its southern extremity.

iii. The Cullarin Fault.

e description of the central—true lake-bottom—e area to a later section, an explanation of the ena, together with further evidence of a convincing ow be given. To anyone versed in geology, the carp constituting the Cullarin Range, especially om an elevation at some distance, is inexplicable fault scarp. Probably the scarp originated as a small faults along the same plane, extending over a period. Indeed the northern scarp is much more g slopes reaching 45° in places) than the southern, portion. One may reasonably suppose that the a was more vigorous to the north and extended to ical period.

cal features of the district are comparatively simple. ception of a few square miles of country near ill (east of the Lake) where there is an interesting ive rocks,* the rock consists of slates and phyllites ly uniform strike nearly north and south, the dip vertical sometimes to the west (Geary's Gap 70°) or ast (Native Dog 63°). On the eastern shore these within the edge of the Lake, but on the west the uptly at the silt. A certain amount of talus from the uted at intervals along the western shore, but wells

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roughly indicated on the map (Plate vii.). Rocks of two t. Granite of a somewhat porphyritic nature, showing some onal metamorphism in the shape of banded felspars, etc., is l) by a complex series of basic and ultrabasic rocks ranging picrites and serpentines. The latter are coated with con- f secondary lime (travertine). This outcrop would seem to vestigation by geologists interested in differentiation.

dug in the vicinity seem to show that this material is in many cases superficial, and lies over the silt and clay which occupies the lake bed (see Section, fig. 1).

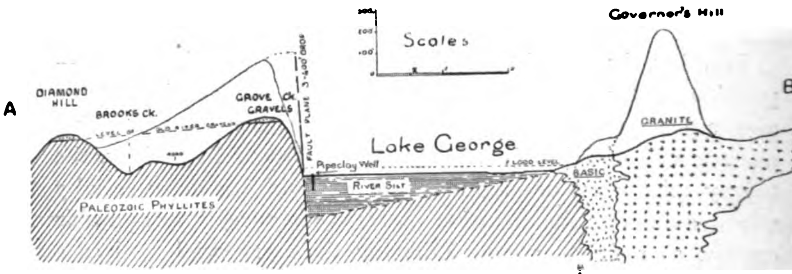

Fig. 1.—Section A B (see Plate vii.) showing the Senkungsfeld and Fault Plane, also the High-level Gravels of the old outlet.

Assuming a *strike fault* as being the cause of Lake George, let us endeavour to reconstruct the topography of the country before the faulting. If the Lake George Basin were raised some 300 feet, the four creeks (Murray, Taylor, Deep and Turallo) would evidently unite into one river, which would flow towards the west and ultimately reach the Yass River above Gundaroo. Some trace of this old river (which we may conveniently call *Lake George River*) should remain in the form of an old valley, which, owing to later erosion on a different system of drainage, should appear much like a *water-gap*. In addition, it is not too much to expect that some of the old river boulders shall have remained, no longer necessarily in the *lowest* portions of the area of elevation (since the latter has been since modified by later stream-action). If, as is often the case, the fault has diminished in extent towards its extremities, we may expect that some (antecedent) river-systems have been able to keep their old path in spite of tectonic obstructions.

All these phenomena are abundantly shown in the Lake George area. Ascending the steep hill face, 300 yards north of Grove Creek, and $1\frac{1}{2}$ miles south of the *present* lowest point of the Cullarin Range, a deposit of elevated river-gravels is reached.

ırds due west from the Lake at this point one
p of the ridge and arrives at a cluster of mine-
in depth from 5 to 40 feet. This patch of gravel
pe, with the long axis W.N.W. and half-a-mile
te vii.). The shafts have been abandoned for
nd do not seem to have yielded much gold. How-
ıbled one to make the rough geological section
fig. 2. The boulders were shaped much like a
e most part, and
rough a deep red
ried in size from a
2 feet in diameter.
f the boulders and
ked by a very hard
s (3") cemented by
material. At the
field, pipeclay was
r levels.
the traverse to-
est (see Section,
l quartz reefs were
ɔke's Creek, which
a rather narrow
ep bluffs (evidence
plift) was reached.

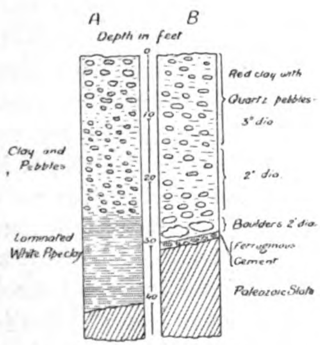

Fig. 2.—Vertical sections in alluvial shafts. A. Central portion of elevated gravels; Diamond Hill. B. Southern margin of elevated gravels; Grove Creek.

hich had a fine flow of water (February, 1907),
n old tributary of the "Lake George River,"
en *revived* by the slight uplift which probably
he senkungsfeld. Enquiring for elevated gravels,
ed of the Diamond Hill Diggings, which lie
m Brooke's Creek in the sharp bend it makes
(see Plate vii.). Here occurs another patch
actically identical in form with that at Grove
e same direction, W.N.W. The area is about 200 ×
the lower 15 feet of the deposit (see A, fig. 2) consists
pipeclay. Here, again, the boulders consist chiefly

of rounded quartz. Returning to the lake-bed itself, just at the mouth of Grove Creek, a well has been sunk thirty feet into the silt. The dump consists largely of pipeclay identical in appearance with that from the shafts *nearly 300 feet higher* on the elevated alluvials. I was informed that boulders of a similar nature to those found at Diamond Hill were removed, but the clay had covered over the early dumpings.

We have no data sufficient to estimate the length and drop of this fault. It extends for more than twenty miles from Collector to Bungendore. Beyond the latter, as the *Molonglo* has cut through the scarp (see page 334), the fault was not so extensive, or the movement may have developed merely as a fold. It is a matter of great difficulty to detect Tertiary foldings superimposed on Palæozoic anticlines, but the river-development would seem to suggest that such faulting or folding has occurred near Molonglo. North of Molonglo River the streams flowing from the west are obsequent, and flow to the lake with short steep beds in narrow gorges. Here, undoubtedly, a fault on a large scale has taken place, and totally altered the drainage system, the tributaries of "Lake George River" being *betrunked* much as are those flowing into Port Phillip (Gregory).

Since the river-gravels at Grove Creek are elevated 270 feet above the lake-bed, we require a *minimum* drop of 270 feet. The well sunk in the silt adds 30 feet. This well by no means reached rock bottom. There is an opinion, shared by the expert local engineer, Mr. Glover, that the silt is 100 or 200 feet deep on the western shore of the Lake. The lesser figure agrees closely with the slope of the line joining the Grove Creek and Diamond Hill gravels (see Fig. 1). Hence it seems legitimate to place the fault drop at about *370 feet* at this locality (Geary's Gap).

Comparing this with the Kurrajong Fault, it would appear to be on a somewhat similar scale. The fault, as described by Professor David,* extends about twenty miles, and has a drop of

* "An important Geological Fault at Kurrajong Heights, N. S. Wales." Journ. Proc. Roy. Soc. N. S. Wales, 1902.

t at the maximum point. It has not, however, led
on of any area of internal drainage as is the case at

ographical Changes since the Faulting.

nto two classes, (a) those due to erosion, (b) those
dation. The
affected the
s (hills, &c.);
r have tended
negative land
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section (vi.).

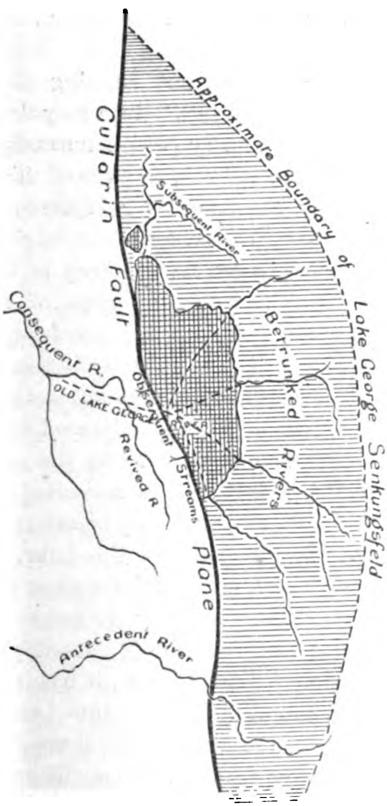

Fig. 3.—Map showing evolution of the river-system in the Lake George area. For topographical names, see text and Plate vii. The area of subsidence is hatched.

The river-courses have been largely influenced by the fault. The Molonglo River being situated toward the southern extremity of the fault plane—where the latter was probably of much smaller dimensions, possibly only a fold—has defied the tectonic changes to alter its course, and it has eroded a deep gorge in the "uplift" side of the fault, and, its course being independent of present land contours, the stream is of the *antecedent* type (see Fig.3).

The small streams running down the face of the fault are typically *obsequent,* since they flow directly against the main slope of the country (which normally falls to the west). Grove Creek, Geary's Creek, &c., are of this character. As pointed out previously, the small rivers of the east coast of the Lake (Murray, Taylor, Deep Creek, &c.) were originally united, but their lower portions are now buried deep in the silt, and therefore they belong to the *betrunked* class of rivers. Brooke's Creek for much of its path flows through fairly deep gorges. This tends to support the theory that the western side of the fault has participated slightly in the earth-movements. Not unusually the scarp of a large fault has been elevated absolutely as well as relatively, and this would appear to be the case at Lake George. If so, then Brooke's Creek is a *revived* river. Yass River, flowing normally to the west, may be taken as a specimen of a *consequent* river. To the north of the Lake, the Currawang Creek flows north-west for most of its course, and then bends back to the south. It is extremely probable that this creek originally formed portion of the Wollondilly system, but, owing to the depression of Lake George, it has been captured by the Winderadeen Creek, and now runs into Lake George. As this deviation is due to causes that acted subsequently to the establishment of the main slope, this river may be said to be *subsequent.* In brief, in this comparatively small area we have examples of the six main river-types, consequent (*Yass*), obsequent (*Grove Creek*), subsequent (*Currawang*), betrunked (*Murray, &c.*), revived (*Brooke's*). and antecedent (*Molonglo*). Finally, the "Lake George" is a splendid example of what has been termed a *dead* river.

this somewhat late stage to the condition of the the Lake, the latter is at present in a very te for examination, since—with the exception of in the S.E. corner shown in Plate vii.—it is now 97) absolutely dry. The bed therefore presents a ance. A level plain, apparently as flat as a billiard for over 15 miles, unrelieved by any islets or is the case with Lake Bathurst. Indeed, the for over 30 miles without obstruction, which fact ed to determine the choice of Bungendore for the ne in New South Wales. Mr. Glover* has carried perations, and finds the south-central portion to feet in the mile, while to the north the slope is t to the mile.

level seems to corroborate the theory that Lake had an outlet since it was first formed. No y flood more than 30 feet deep can be traced as ed for many hundred years, while nearly 200 feet to provide an outlet north, west or south. *e its inception* the Lake has been receiving silt ually filled up its bed, and covered over all ancient Near Grove Creek there is an isolated ridge of grit about 150 feet long, 50 wide, and 5 feet high. esent a sort of *Nunatak* (to use a glacial term) ve the silt. It constitutes practically the only western shore. At either end of the Lake—near oon and near Bungendore—there are extensive The former extends for more than a mile around border of Murray's Lagoon (see Plate vii.). It resistibly of the clinker or *hurricane banks* of coral Barrier Reef. There is the same steep slope to

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Floods in Lake George," by H. C. Russell, B.A., F.R.S., . Roy. Soc. N. S. Wales, Dec., 1886. In this paper a full velling and contours of the Lake is given, together with the ke till 1886.

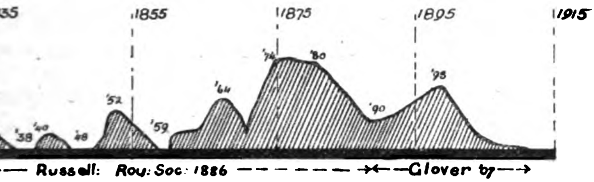
the water's edge, 30 feet high, at an angle of 26°. The s
tongues project out behind to the leeward side (indicate
Plate vii.). Probably a like origin may be assigned to t
gravel-banks. They are due, I think, to the action of the st
on the lake when the latter is full. The winds are confine
the gigantic wall of the fault scarp, and rush along the la
driving forward the angular talus with which the scarp is litt
Gradually the angular fragments are rounded and colle
the ends of the Lake, in much the same way as on a coral
the clinker gradually accumulates towards the lee side of
reef.

V. Economic Aspect of the Senkungsfeld.

Little attention has hitherto been paid in Australia to
relation between physiography and economics, which fact
justify the following brief digression. In the first place me
may be made of the gold alluvial rendered available for hu
industry by the deviation of water from the old Lake G
River. In 1860 there was a gold rush to Diamond Hill,
called the Brooke's Creek Gold Rush. From the numerous s
sunk, as well as from the recollections of old residents, this
appear to have been fairly successful. Several years ago,
diamonds were washed out of this same gravel, and henc
change of name. Grove Creek gravels do not seem to have
payable. The miners experienced great difficulty in cu
through the layer of ferruginous cement at the bottom o
gravels, and most of the claims were therefore abandoned.
the old wives of the district use the pipeclay for whitening
hearths, without experiencing much curiosity as to how i
there.

The graph of Lake-variation is inserted (*vide* fig.4) to
the periods when Lake George really was a lake. Such wer
years 1816-1830, 1852, 1864, 1874-1900. Since 1900 the Lak
been shrinking, and was practically dry in 1905. A local
has practically no effect on the Lake. The dry silt acts as a
sponge, and absorbs a covering of several inches of water, br
down by Deep Creek or some other feeder, in the course

nditions are eminently favourable for great evapora-
nd will drive a layer of water several miles from



Variations in the level of Lake George, 1815-1907.

est spot, and before it can flow back the sun's heat it for the atmosphere.

ottom is now covered with a wiry form of grass, oving buttercup, and with several plants allied to These latter flourish in the saline soil, and are by sheep after they become used to the new food. a is a new importation, I was assured. The Lake ed into grazing leases, and fences run nearly across local sheep-breeders for the most part much prefer , since many extra sheep can be carried on their of a very pure type can be obtained almost any- he western shore, at a depth of 12 to 30 feet, and nills are now engaged in raising it to elevated tanks on. At the same time the neglected boathouses, ecaying boats and launches which are to be seen lore, recall the good old times when the Lake Murray cod, to be replaced later by carp; and when d other game were in the habit of frequenting the water.

ed foreigners, in the shape of foxes and rabbits, culated to equal the old fauna from an economic

to 1864, the Lake was only for one year (1852) feet deep, so that the indications seem to point ntinuance of the present arid conditions, so far as judge from records not yet extending over a century.

The graph (fig.4) is drawn from that given in Russell's paper (quoted above), and brought up to date from information given me by Mr. Glover, who keeps an official record of the meteorology of Lake George.

vi. Age of the Subsidence.

Mr. Russell made use of Lake George as a *gigantic rain-gauge*, and, from the data he obtained, he put forward some very interesting theories as to weather cycles and their causes. It has occurred to me that Lake George may serve as a *geological chronometer* for much the same reason, that it "keeps all it gets," whether water or silt. The foregoing sections will demonstrate the reasonability of stating that Lake George probably never had an outlet. Hence the *silt* deposited in Lake George should give us some idea of the time which has elapsed since the extensive faulting instanced took place.

All the data made use of are open to criticism, but it is hoped that the method used may be of interest, and that the result may represent a period of years of the right *order* if not correct to a few hundred units.

From Russell's textbook on Rivers* I obtained the following figures for the silt-deposits of the River Po in North Italy; and corresponding numbers for Lake George are tabulated alongside.

Table i.

		River Po.	Lake George.
A.	Area of Basin	30,000 sq. m.	300 sq. m.
B.	Rainfall (H.R. Mill) ...	30 inches p.a.	25 inches.
C.	Ratio $\frac{\text{silt}}{\text{water}}$	$\frac{1}{900}$	$\frac{1}{2000}$
D.	Silt deposited per annum	67 million tons.	$\frac{\text{3,400 mill. tons.}}{x \text{ years.}}$

A. (Area) gives the amount of material to be acted on.
B. (Rainfall) gives the effective eroding agent.

* River-Development. By I. C. Russell, 1898, pp.74-5.

ater) varies with the different rivers from 1 in 2000 to 1 in
value would double the period in years, and is perhaps
ct as the Po drains a *glaciated* country covered with débris.
ake George was supposed to occupy a wedge 10 miles long,
a base 100 feet deep. (This is probably too small a bulk).
ne of 68,500 million cubic feet. Since a cubic foot of sand
lbs., this represents a weight of 3,400 million tons as
a period of x years.

in question is $\frac{1}{100}$ of that drained by the river
nfall and silt-carrying power less for Lake George,
y put down $\frac{67,000,000 \times 25 \times 900}{100 \times 30 \times 2000}$ as the amount
ke George in one year (= 250,000 tons).

million tons will be deposited in $\frac{3,400,000,000}{250,000}$
oughly 14,000 years; a result which is quite as
as could be expected. No account has been taken
factor, which is very important in connection with
If the velocity were lower than the mean velocity
would increase the period. If the rainfall, as is
heavier in prehistoric times in Australia, it would
riod. However, one may perhaps be permitted to
uge senkungsfeld as having taken place less than
nd years ago.

vii. Summary.

, the largest lake in New South Wales, occupies
bsidence (*senkungsfeld*) bounded on the west by a
about 400 feet drop. The fault is approximately
strike of the Palæozoic slates and phyllites. It
south for thirty miles, and constitutes the Cullarin
violent tectonic changes have entirely altered the
n of the district. The Molonglo flows through a
in the Cullarin Range, and is clearly an antecedent
ders of Lake George once formed part of the Yass
Their lower portions are buried under the silt of
and they thus fall into the class of betrunked

rivers. The old outlet (Old Lake George River) can be traced as a series of elevated river-gravels for three miles towards the Yass River. The boulders, some over two feet in length, cap hills nearly 300 feet above the present level of the lake-bed. The economic aspects of the senkungsfeld in connection with elevated auriferous alluvials, and the pastoral claims on the lake-bed are traced out.

From a comparison with the known silt-forming capacity of the basin of the River Po in Italy, an attempt is made to give a time-value to the silt-contents of Lake George. A period of less than twenty thousand years is shown to be sufficient to fill up the lake basin to its present silt-level under modern conditions. Hence the fault and senkungsfeld may be referred to a period contemporaneous with the close of the Great Ice Age in the northern hemisphere, and probably to the period during which the Blue Mountain folding at Lapstone Hill took place in New South Wales.

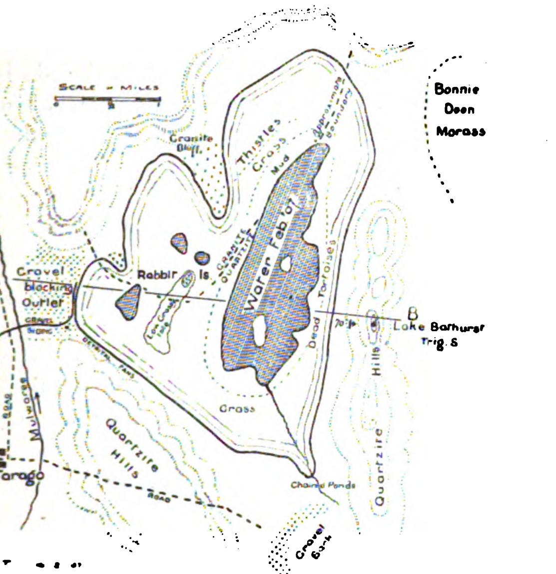
Part ii. Lake Bathurst.

1. General Physiography.

This Lake lies about twelve miles to the east of Lake George, on the further side of the Cooma railway line, which approaches within a mile of the lake near Tarago (see fig.5 and stereogram, Plate viii.). It is roughly triangular in outline, with the base to the east. Quartzite hills about 200 feet high border the east and south-west sides, while an area of granite extends into the lake-bed on the north-west, forming a long reef connecting Rabbit Island to the bluffs of the surrounding hills.

At each corner is an area of low-lying land. To the north-east a low bank separates the lake from the Bonnie Doon Morass. At periods of flood the two areas form one sheet of water. The southern corner receives the main feeder of the lake, known locally as Chain o' Ponds. Here is a considerable extent of gravels. At the western corner of the lake the gap between the hills is filled in with another extensive deposit of gravels which has been tapped by a railway siding for ballast purposes. When

has an area of five square miles, and is thus very than Lake George.



.—Map of Lake Bathurst showing its physiography 7). The boundary between the granite and quartzite ed approximately.

ruary, 1907, I made a careful survey of the Lake, se of determining the area covered by water, and of the dam to which the lake owed its origin. road and approaching the Lake from the south, one e of coarse quartzose sand with subangular frag- zite, evidently derived from the neighbouring hills. one of grey sticky mud about 200 yards wide, and er was reached. This was very brackish and covered cum. The mud gave off a musty smell, recalling n guano reefs, and was possibly due to the same flock of gulls were swimming in the northern e lake. Journeying eastward across the Chain o'

Ponds, one traversed a sandy mud with occasional flat-growi fleshy weeds. The coarse grass at the foot of Lake Bathu Trig. Station was littered with dead tortoises. One passed th or four every yard, mostly about a foot long. These repti were driven out of the lake in the autumn of 1906 by the incre ing salinity, and as there is no permanent water on the east shore, perished. In some such manner, no doubt, many of huge deposits of vertebrates found fossil in various parts of world took their origin. From the Trig. Station a fine view the lake basin and surroundings is obtainable (fig.7). Rab Island is a prominent feature, large wattle-trees growing a the huge granite blocks which have determined the isla The well-defined gap to the south-west at the gravel-sid shows up as the lowest portion of the lip of the basin.

Continuing along the north-east shore, granite outcrops met with, their position being shown on the map. At northern end is the deepest part of the Lake, about one foot d in February, 1907. Prominent bluffs of granite occur on north-west shore. Completing the traverse by way of Rab Island (which is now merely a mound in a thinly grassed paddo a series of *detrital fans* is crossed. These bear witness to vigour of the torrents rushing down the hillsides, and hav bearing on the origin of the Lake.

Not many years ago sculling matches took place on the L between Rabbit Island and the gravel-siding, which latter also used to convey passengers to the recreation ground on edge of the lake. With the drying of the lake, the attract of the recreation ground has passed; and the pavilion, a promin and useful landmark, has now degenerated into a stable.

Referring to the section across Lake Bathurst (fig.6), geological features near the gravel-siding can be made About half-a-mile to the west of the lake, the Mulwaree Cr flows to join the Wollondilly-Hawkesbury system at Goulb This stream rises about ten miles south of the Lake, and drai fairly large basin. Between Tarago and the Lake-outlet, valley contracts so that the stream flows at the foot of rat

zite ridges, about 300 feet high. These ridges are
h a loose talus which is continually dropping into the

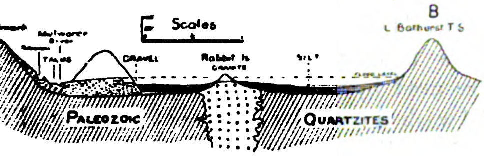
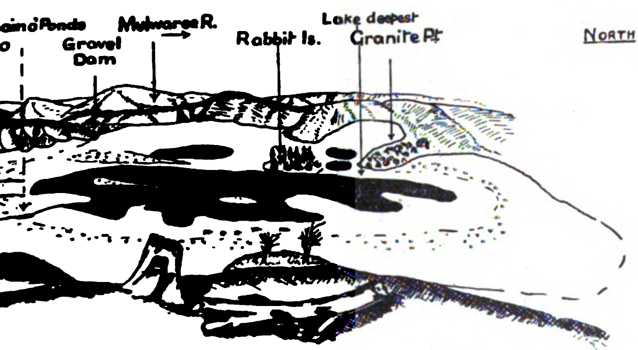


Fig.6.—Section A B (see fig.4) across Lake Bathurst,
wing the gravel-dam across the outlet and the *talus*
upying the Mulwaree Valley.

the railway cuttings 30 feet or more of this talus
th soil) are evident.

anation of the lake-origin which I venture to put
ntimately connected with this abundance of talus in
valley of the Mulwaree.



ketch view of Lake Bathurst from the top of the Trig. Station
rn shore. The black area indicates the extent of water in
07. When filled, the Lake covers the whole flat expanse.

ii. Origin of Lake Bathurst.

geological periods, possibly when a somewhat greater
ained in New South Wales, the Mulwaree Creek
air of tributaries from the east. One of these drained
ow occupied by the Bonnie Doon Lagoon (N.E.), and

the other held much the same position as the Chain o' Ponds (S.E.) does now. These creeks crossed the bed of Lake Bathurst, and entered Mulwaree Creek near the gravel-siding.

During periods of drought, these lesser lateral streams would probably cease flowing, and their entrance into the main creek, not being scoured by any current, would very readily be choked by material washed down by the parent stream and derived from hills in the immediate vicinity.

Thus would arise a shallow lake which, given periods of increasing aridity, would serve as a settling ground for the water poured in by the two small tributaries postulated above.

Talus and pebbles brought down into this youthful lake would be rolled about by the storms (which are still a feature of the lake when flooded) and piled in the angles, giving rise to the gravel mentioned as occupying those positions. Each succeeding period of flood would but serve to isolate the lake more and more, by enabling further material to be piled on the barrier, which would also be strengthened by the talus distributed by the Mulwaree Creek on the outer face of the dam.*

Given conditions of increasing aridity, a main stream flowing through a narrow talus-covered gorge, and a lateral valley of circumscribed cross-section receiving the drainage of a much smaller area; these, I believe, constitute the factors which have led to the isolation of Lake Bathurst.

In conclusion, a few dates in connection with Lake Bathurst may be noted.

1844. Lake Bathurst dry.

1870-8. A "banker," as in Lake George.

1873. The Lake overflowed into the Mulwaree over the gravel-siding.

1890. The lake rose to the lower rails of the siding. Within a few feet of overflow. Goulburn residents anxious as to danger of flood if the gravel-dam burst.

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* Readers of the National Geographic Magazine will recall the origin of the Salton Sink in California, due to damming up of a lateral valley by silt carried down by the Colorado River.

1907. One-quarter of the bed covered, not more than one foot deep in the larger area.

From these dates one can see that the floods in Lakes George and Bathurst agree sufficiently closely. Their modes of origin are, however, entirely dissimilar, Lake Bathurst being merely a dammed-up river valley, while Lake George is an example of a huge senkungsfeld and fault-scarp which has absolutely altered all the original drainage-scheme of the area comprised in its basin.

In conclusion, I desire to thank Messrs. J. Barrett (Tarago), Gill (Winderadeen), Glover (Bungendore), and Donelly (Douglas) for much help received while carrying out my investigations on Lakes Bathurst and George.

EXPLANATION OF PLATES.

Plate vii.

Map of the Lake George "Senkungsfeld" and Fault Scarp (Cullarin Range). The granite area is only approximate. The high-level gravels (making the old outlet) are indicated to scale as black oval patches. The extent of water in February, 1907, is shown by the hatched area on the east of the lake.

Plate viii.

Stereogram of Lake George showing the area of internal drainage. The high-level gravels, south of Geary's Gap, are marked. The antecedent valley of the Molonglo appears at the lower end. In the north-east the main features of the Lake Bathurst area are indicated.

Plate ix.

A view of the Lake-bed in February, 1907. The Lake has been practically dry for four or five years, and is sparsely covered with a nutritious salt-bush on which the sheep may be observed to be feeding.

Plate x.

From a photo taken in 1884 when the Lake was nearly full of water. The irregular eastern coastline culminating in Governor's Hill (to the right) appears in the background.

STUDIES IN AUSTRALIAN ENTOMOLOGY.

No. xv. New Genera and Species of Carabidæ, with so Notes on Synonymy (Clivinini, Scaritini, Cunipect Trigonotomini and Lebiini).

By Thomas G. Sloane.

(Continued from Vol. xxix., 1904, p.538.)

BIPARTITI.

A character which differentiates the two tribes of the Bipa (as represented in the Australian fauna), but which has not b noticed, is the seta near the tip of the basal joint of the ante on the upper side; this is present in all Australian species of Clivinini, but absent in all our representatives of the Scari My data are not sufficient to enable me to report on this fea in the faunas of other parts of the world, but the specie *Scarites* which I have examined have had no trace of this set

Only once have I seen a member of the tribe Scaritini in w this seta was present; viz., one specimen of *Scaraphites le* Westw., (a species in which the seta is normally wanting). seems a case of atavistic reversion, suggesting that the Scar are descended from a stock in which the seta was present, an strengthening my impression that the present day Scaritini less ancient than the Clivinini.

Tribe CLIVININI.

Genus Clivina.

Clivina banksi, n.sp.

Elongate. Head wide before the eyes; elytra strongly punc striate, fourth stria joining fifth at base, interstices gre raised near base, eighth carinate near base, narrow and cari on apical curve; anterior tibiæ strongly 3-dentate, paronycl

e; prosternal episterna almost lævigate (hardly substrio-
ubrugulose anteriorly); peduncle with lateral cavities
. Black (elytra sometimes with an obscure ferruginous
pical curve above eighth interstice), legs ferruginous.
ooth between facial carinæ, a few punctures on each
sterior extremity of facial carina; clypeus with median
y emarginate, strongly bordered, "wings" not divided
n part, rounded externally, lightly concave, rugulose;
nnal plates wide, rounded and bordered externally,
livided from "wings" of clypeus. Prothorax convex,
little longer than broad (2·55 x 2·4 mm.), widest a
re posterior angles, decidedly narrowed anteriorly
anterior line deep; median line well marked. Elytra
dest a little behind middle (5·3 x 2·7 mm.); base trun-
very deep anteriorly, shallow—but marked—pos-
nterstices convex, very strongly so towards base.
n with intercoxal part wide anteriorly, transversely
posterior declivity. Length 10, breadth 2·7 mm.

.: Normanby River, 40 miles south-west from Cook-
ne; two specimens on the river-bank; June, 1906);
(Olive; Coll. Sloane).

so closely resembling *C. australasiæ* Bohem., that it
aken for that species at the first glance, it is really more
leai Sl., from which it is at once differentiated by its
r size, elytra not with the whole apical fourth reddish,
C. australasiæ it differs (apart from its less opaque
r) by its almost smooth prosternal episterna; peduncle
al cavities impunctate; anterior tibiæ with fourth
th obsolete, paronychium longer, obtuse at apex; head
much less punctate on gulæ; elytra with interstices
raised near base; wide basal part of inflexed margin
ongitudinal punctate stria, etc.

CLIVINA PLANIFRONS, n.sp.

parallel; head depressed, clypeus emarginate as in *C.*
(but a little more deeply so); elytra with fourth stria

joining fifth at base; prosternum as in *C. australasiæ* (but episterna not perceptibly transversely striolate); anterior femora short, wide, with lower side rounded and bordered on posterior margin; anterior tibiæ strongly 4-dentate. Head, prothorax, and anterior legs piceous-red; elytra piceous-black; body piceous beneath; four posterior legs testaceous.

Head with vertex and front flat, this depressed area extending on each side to eyes and backwards in a curve behind level of eyes; front without the usual facial carina on each side near eyes. Prothorax lævigate, convex, quadrate (2·2 x 2·25 mm.), very little narrowed to apex; median and anterior lines well marked. Elytra a little wider than prothorax (4·75 x 2·5 mm), parallel on sides, widely rounded at apex; base truncate; striæ not deep, punctulate, seventh not interrupted posteriorly; interstices lightly convex. Length 6·5-8·5, breadth 1·75-2·5 mm.

Hab.—Q.: Brisbane (Hacker; Colls. Hacker and Sloane).

This species was sent to me by Mr. Henry Hacker ticketed "Brisbane." It is allied to *C. cava* Putz., which is the only Australian species with which it can be confused, but it differs from *C. cava* by colour; head more depressed, the depressed area occupying all the space between the eyes, so that the supraorbital setæ rise under its lateral edge, and the facial carinæ become altogether lost (in *C. cava* the facial carinæ are well developed and distinct).

Clivina hackeri, n.sp.

Robust, oval; head small; prothorax subtrapezoid, narrowed anteriorly; elytra convex, shortly oval; metasternum small, hardly more than half the length of posterior coxæ between intermediate and posterior coxæ; peduncle with lateral concavities small, smooth; legs short, stout, anterior tibiæ strongly 3-dentate with a slight protuberance above upper tooth.

Head as in *C. nyctosyloides* Putz.; clypeus with median part truncate, the "wings" lightly advanced beyond median part, gently oblique on inner side; mandibles short, stout; labrum short, 7-setose. Mentum large; lobes wide, obtuse, oblique on

.nus shallow; a very wide, prominent, roundly obtuse,
ess in sinus. Antennæ stout; second joint longer
joints 4-11 moniliform, compressed. Prothorax
isverse (2·8 x 3·5 mm.), widest just before posterior
:ly narrowed to apex (2·1 mm.); sides oblique; apex
anterior angles widely obtuse, subprominent; pos-
s obtuse but marked; basal curve short; border
re on basal curve; anterior line well marked near
rgin; median line distinct. Elytra short, oval
very convex, deeply but roundly declivous to peduncle;
uite rounded off; striæ strongly impressed, finely
bottom, seventh as strongly impressed as others and
to apex; interstices convex, first with a very short
se, third 4-punctate, eighth entire, wide and convex
rve; lateral channel closely catenulate (with punctate
bottom. Prosternum with intercoxal part wide,
nelled between coxæ; posterior declivity transversely
ut not sulcate. Tarsi short, anterior with first joint
four succeeding joints together; intermediate tibiæ
ssate, outer edge denticulate, external spur stout,
a little above apex, another short spur a little above
11, breadth 4 mm.

Coen (Colls. Hacker and Sloane).

stinct species without any close relationship to any
alian species. Its short broad form, with short oval
runcate at base) distinguish it from all our species.
f a few species with short metasternal episterna;
may be placed near *C. nyctosyloides* Putz., which it
enerally in form of head, prothorax, and peduncle,
ry distinct by its smaller metasternum with shorter
lytra not truncate on base, eighth interstice distinct
n and hardly reduced in width near apex. It has the
red together and the underwings reduced to a mere
mbrane, characters which seem to differentiate it
ther species of the genus. Mr. Henry Hacker
e that he obtained only three specimens one morning

(18th Jan., 1906) after rain, crossing a track in open forest land; from this it would appear that it is not a riparian species like the typical species of *Clivina*.

Tribe SCARITINI.

Genus SCARAPHITES.

SCARAPHITES HIRTIPES Macleay.

By a vexatious error in my Check-List of the Australian Carabidæ, Pt. i. (1905), *Sc. hirtipes* Macl., has been placed as a synonym of *Sc. latipennis* Macl. The differences between these species and their synonymy have been dealt with by me in these Proceedings (1905, pp. 111 and 112), and I still hold the views there expressed.

SCARAPHITES LENÆUS Westwood.

Since dealing with *Sc. lenæus* Westwood, in these Proceedings (1905, p. 111), I have received from Mr. J. A. Kershaw of Melbourne, a specimen ticketed *Scaraphites martini* Cast., which agrees more closely with Westwood's figure than the specimen of *Sc. latipennis* Macl., which I formerly identified as *Sc. lenæus*. Mr. Kershaw's specimen has the prothorax with the sides more strongly sinuate posteriorly, and the basal angles far more strongly marked than in Mr. Lea's specimen (in which these features are feebly developed); thereby showing a stronger resemblance to Westwood's figure, though to me both specimens seem forms of one species—this suggests that *Sc. latipennis* Macl., from King George's Sound, is probably a slightly differentiated form or variety of *Sc. lenæus*, the typical form being from the West Coast. The ticket on Mr. Kershaw's specimen is an old one, and seems to offer a clue to the identity of *Sc. martini* Cast., with *Sc. lenæus* Westw., rather than with *Sc. silenus* Westw., as conjectured by me (these Proceedings, 1905, p.111).

Genus EURYSCAPHUS.

In these Proceedings (1905, p. 113) I have said that the type of *Euryscaphus carbonarius* Cast., is no longer in existence.

ershaw informs me, however, that there is a specimen
ıst have overlooked) in the Howitt Collection—at
nis charge—ticketed *Scaraphites carbonarius* Cast.
pped the vexed question of the identity of this species
ed authoritatively sooner or later by an examination

Genus LACCOSCAPHUS.

LACCOSCAPHUS QUADRISERIATUS, n.sp.

oval, robust, convex; head with two supraorbital
n each side; each elytron with four rows of deep
ior tibiæ 3-dentate. Black, margin of prothorax and
ottoms of elytral foveæ cupreous.

nsverse-quadrate (4·9 mm across eyes); frontal sulci
rgent backwards, connected behind by a rounded
three subequal frontal spaces clearly defined from
s small, lightly convex, not prominent. Prothorax
nsverse (4·25 x 6·3 mm.); sides subparallel, rounded
angles, lightly sinuate on each side of the wide basal
or angles roundly obtuse, a little advanced but not
border thick, reflexed, a little narrower on sides than
of basal curve, not reflexed in middle of basal lobe;
distinct; a transverse line defining basal area; a wide
ded impression before each side of basal lobe; four
nctures on each side, anterior puncture just behind
gle. Elytra convex, ovate (10 x 6·3 mm.), widest
le, a little narrowed to base; sides slightly rounded;
truncate-emarginate behind lobe of prothorax; four
e deep foveæ on each elytron, and a row of ocellate
laced in foveiform depressions along sides; border
turned (but roundly obtuse) at humeral angles.
, breadth 6·3 mm.

stralia (type in Coll. Deutsche Entomologische
useum, Berlin).

Proceedings (1905, p.116)I have given a synoptic
species of *Laccoscaphus*, following which the position

of *L. quadriseriatus* would be next to *L. foveigerus* Chaud. The described species of *Laccoscaphus* with four rows of foveæ on each elytron and the lateral ocellate pores placed in foveiform depressions are *L. foveigerus* Chaud., *L. quadriseriatus* Macl., *L. lacunosus* Macl., and *L. macleayi* Sl.; these species are all so closely allied to one another that it seems probable they are colour-varieties of one variable and widely distributed species rather than distinct species. *L. quadriseriatus* differs from all the species mentioned above by the margins of the pronotum and elytra and the bottoms of the elytral foveæ being cupreous; size larger; form more convex; prothorax with anterior angles more obtuse and less prominent, sides more decidedly rounded to anterior angles, base less strongly sinuate on each side—owing to the basal lobe being less developed; elytra more convex, with more numerous foveæ in all the rows. *L. quadriseriatus* is the same size as *L. spencei* Westw., from which it differs by colour, the presence of a juxtasutural row of foveæ on the elytra, &c. A single specimen was sent to me by Herr Sigismund Schenkling, ticketed "New Holland"; I should expect its habitat to be tropical Australia.

Genus CARENUM.

CARENUM FORMOSUM, n.sp.

Elliptical-oval, lævigate; head convex, frontal sulci parallel, suborbital channel single, lower edge forming a ridge; prothorax convex, transverse, lobate, anterior angles strongly advanced, lateral margins wide, bipunctate; elytra ovate, convex, bipunctate towards apex; anterior tibiæ 3-dentate, posterior tibiæ slender. Head black with a faint violaceous tinge posteriorly above and below; prothorax widely margined with green (including anterior margin), disc deep purple-black; elytra violet with green reflections, becoming green near margins; inflexed margin of prothorax and elytra green; prosternum black with episterna viridescent; body black; mes- and metepisterna and ventral segments laterally viridescent; legs, antennæ and palpi black, antennæ on sides of apical joints and apex of palpi reddish-piceous.

verse (4·3 mm. across eyes); anterior margin truncate
rmediate angles, arcuate outside intermediate angles;
parallel, not deep; preocular sulcus lightly marked;
cess small, rounded; eyes reniform, lightly convex.
ransverse (3·2 x 5·7 mm.), much wider than head,
ivous to base; sides lightly rounded; posterior
ed off; anterior angles strongly advanced, roundly
lobe well developed, rounded; a strong sinuosity on
basal lobe; border widely reflexed, most strongly so
angles; marginal channel wide; median line lightly
ytra ovate (7·7 x 5·5 mm.), lightly rounded on sides;
y declivous, punctate; lateral channel wide; border
ngly upturned at humeral angles; a row of closely
ate punctures along lateral margins. Prosternum
xal part lightly and widely channelled, truncate at
rginal punctures on each side. Legs light; anterior
wollen in middle; anterior tibiæ with upper external
small, surmounted by two small denticulations.
breadth 5·7 mm.

W. Australia: Carnot Bay (type Coll. Sloane).

species to the kindness of Mr. C. French; it belongs
aragdulum group and is allied to *C. virescens* Sl., but
maller size; lighter form; eyes more convex, more
ed in smaller orbits posteriorly; lateral channel much
sinuosities on each side of prothoracic basal lobe
reflexed at these sinuosities); elytra narrower, and
on sides, disc of a beautiful metallic-blue colour.
appearance it closely resembles *C. froggatti* Sl., but
edly by head wider, more convex, anterior angles less
nterior margin not sloping forward on each side to
ntermediate angles, frontal sulci parallel, eyes less
prothorax more transverse; elytral margin wider;
with intercoxal part not deeply longitudinally

CARENUM RUTILANS, n.sp.

Elongate-oval, convex, lævigate; head with frontal sulci strongly divergent posteriorly, two supraorbital setigerous punctures on each side; prothorax with posterior angles rounded, base lobate, marginal channel narrow, 2-punctate; elytra oval, 2-punctate on apical third; anterior tibiæ 3-dentate. Pronotum and elytra nitid-green with purple tints on discal parts in some lights; inflexed margins of elytra green; head black, occiput virescent on each side at posterior extremity of frontal sulci, under-surface with purple tints behind mentum; prosternum nigro-virescent; body black, mes- and metepisterna virescent; legs black, tarsi and antennæ piceous, palpi reddish-piceous.

Head large (3·5 mm. across eyes), convex, smooth; anterior margin with intermediate angles small, triangular, arcuate outside intermediate angles; clypeus truncate and declivous between intermediate angles; frontal sulci deep, strongly divergent and defining lateral frontal spaces posteriorly; preocular sulcus short, distinct; preocular process small, rounded externally; supraorbital sulcus not extending downwards behind eyes to join suborbital channel; eyes convex, prominent; orbits not prominent behind eyes. Prothorax not much wider than head (2·75 x 4mm.), evenly convex, roundly and strongly declivous to base; sides hardly rounded in middle, very lightly narrowed to anterior angles, widely and evenly rounded posteriorly; anterior angles a little advanced, obtuse; basal lobe strongly developed, rounded; border narrow, reflexed, sharply sinuate on each side of basal lobe, thicker on basal lobe; marginal channel narrow, a little wider round posterior angles; median line narrow. Elytra oval (6·3 x 4·25 mm.), convex, evenly rounded on sides; base strongly declivous to peduncle; margin explanate at apex; border roundly reflexed, prominent at humeral angles; inflexed margin wide, widely vertical at apex; a row of closely placed ocellate punctures along sides; basal declivity punctate. Length 12·5, breadth 4·25 mm.

Hab.—Central Australia: Tennant's Creek (unique; Coll. French).

the *C. smaragdulum* group; by its head with two punctures it shows an affinity to *C. odewahni* Cast., *ictum* Macl., but it is at once differentiated from by the prothorax with only two lateral setæ, in this *C. froggatti** Sl., to which, however, it has no close ring by its very widely securiform apical joint of the prothorax with marginal channel and border not

CARENUM MOROSUM, n.sp.

oval, convex, lævigate; head with one supraorbital side; prothorax transverse, lateral margins without unctures, base sinuately subtruncate without median cordate, impunctate on disc and on basal declivity; æ 2-dentate, intermediate tibiæ stout, incrassate, with ed spiniform spur at outer apica langle. Black.

ge, convex (6 mm. across eyes); frontal sulci deep, reaching back as far as base of eyes; eyes rather strongly inclosed in orbits at base. Prothorax 5 × 7 mm.), convex; sides lightly rounded, subparallel very lightly narrowed to anterior angles, these obtuse, more strongly narrowed to posterior angles, ed but marked; border strongly reflexed, narrow on des, much wider near anterior angles, widely explanate angles, widely subsinuate on each side of base behind igles, narrowed and emarginate on middle of base; deeply impressed; a well marked foveiform impression of base about half-way between posterior and median a hardly wider than prothorax (9·6 × 7·2 mm.); base rginate, truncate; sides gently narrowed to apex; xed, strongly so towards base, upturned at humeral eral channel wide behind humeral angles; lateral nctures widely placed (about twelve on each side).

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iginal description of *C. froggatti* the anterior tibiæ are twice ne first time erroneously as bidentate; they are tridentate.—

Prosternum with intercoxal part longitudinally channelled and with one setigerous puncture on each side. Posterior coxæ with one setigerous puncture; posterior trochanters with a setigerous puncture on inner side near base. Length 19·5, breadth 7·2 mm.

Hab.—Victoria: Grampian Mountains (unique; Coll. French).

Belongs to the *C. lævipenne* group,* which includes *C. lævipenne* Macl., *C. ineditum* Macl., (I have doubts as to the distinctness of these two species), *C. cordipenne* Sl. (remarkable for having the paragenæ setigero-punctate beneath suborbital scrobe), and *C. politulum*† Westw. *C. morosum* is allied to *C. lævipenne*, but differs by colour wholly black; prothorax more parallel on sides, much more lightly narrowed to anterior angles, posterior angles more prominent and marked, border much more widely reflexed; base of elytra without ocellate punctures near humeral angles; intermediate tibiæ stouter and with a more decided spine at outer apical angle. It is remarkable to find in *C. morosum* the basal declivity absolutely without punctures; another black Victorian species, viz., *C. amplipenne* Sl., has only one puncture on each side, and *C. lepidum* Sl., has sometimes the base with one puncture, sometimes with none; *C. lepidum* has no affinity to *C. morosum* and *C. amplipenne*, and these two latter species differ decidedly from one another.

Genus Carenidium.

Carenidium longipenne, n.sp.

Elongate, depressed, lævigate. Labrum deeply emarginate; prothorax very little broader than long, two marginal setigerous punctures on each side; elytra long, narrow, impunctate, strongly bimucronate at apex, border not dentate at humeral angles;

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* *Cf.* these Proceedings, 1900, p.366.

† I believe from Westwood's figure of *C. politulum* that it exactly resembles *C. lævigatum* Macl., in form of legs, shape of prothorax and colour; in fact, I have always inclined to think Westwood's description was founded on a form conspecific with *C. lævigatum*, in which the two discal elytral punctures were absent.

anterior tibiæ bidentate. Black, prothorax and elytra widely margined with green.

Head 5·2 mm. across eyes, subdepressed, smooth; frontal sulci long, deep, diverging backwards, anterior part turning outwards in a light linear course; clypeus with median part emarginate, declivous, intermediate angles strong, dentiform; eyes convex, not prominent; orbits large, rising gently from sides of head, as prominent as and enclosing eyes; two supraorbital punctures on each side. Prothorax a little broader than long (5 × 5·5 mm.) depressed on disc, not declivous to base in middle; sides subparallel; narrowed gently anteriorly before marginal seta, widely rounded at posterior angles, lightly sinuate on each side of base; anterior margin truncate; border narrow, hardly produced at anterior angles, stronger and continuous between posterior marginal setæ. Elytra hardly as wide as prothorax, elongate-parallel-oval (12 × 5·4 mm.), lightly depressed towards base; strongly and subobliquely declivous on sides; humeral angles rounded; base truncate; each elytron terminating in a strong cylindrical sharply pointed mucro; a row of separate punctures along sides; four punctures on base of each elytron. Ventral segments 3-5 bipunctate; apical segment with reflexed edge foveate on each side of apex. Legs light; posterior coxæ and trochanters impunctate. Length 23·5, breadth 5·5 mm.

Hab.—W.A.: Norseman (W. A. Sayer; Coll. French; unique).

This species is characterised by its long narrow parallel form; it belongs to the *C. mucronatum* group, in which the elytra are bimucronate at the apex. From *C. mucronatum* Macl., it is at once distinguished by its smaller size, much more narrow and elongate form, longer apical mucrones, &c. It is more allied to *C. leai* Sl. (the other species of the group), with the description of which it agrees in the general characters of head and prothorax, but from which it is evidently distinct by its more slender form; elytra with margins of depressed discoidal area not "sharply defined" nor ending in a subtuberculate elevation on each side. The apical declivity slopes evenly to the long pointed apical mucrones, and the disc is only depressed (slightly) on the anterior half.

Tribe CUNEIPECTINI, n.trib.

Head not narrowed behind eyes, one supraorbital seta on each side; eyes round, distant from buccal fissure, not inclosed at base. Antennæ with three basal joints glabrous. Mentum deeply emarginate, toothed. Prothorax widely margined; posterior marginal seta on explanate border just before basal angle. Elytra not bordered on base, strongly punctate-striate, dorsal interstices without setigerous punctures; margin decidedly interrupted posteriorly and with a strong internal plica. Prosternum with intercoxal part shortly prolonged backwards in a wedge-shaped process. Mesosternum wide and deeply excavate between intermediate coxæ; epimera not attaining coxæ. Metasternum and first ventral segment meeting and rather widely dividing posterior coxæ; episterna short, wide. Ventral segments 4-6 with a strongly defined and wide raised margin or "collar" along anterior margin. Legs stout; tibiæ wide at apex, anterior emarginate on inner side towards apex, inner spur above emargination; posterior coxæ 3-setose.

I would place the tribe Cuneipectini at the beginning of the Trigonotomid series of the subfamily Harpalinæ.

CUNEIPECTUS, n.gen.

Head stout, convex, not narrowed behind eyes; one supraorbital seta opposite middle of eye on each side. *Antennæ* setaceous, short, reaching to base of prothorax; three basal joints glabrous, first stout, not long (1 mm.), second shortest (0·65 mm.), third longest (1·4 mm.). *Labrum* large, subquadrate; a longitudinal median line from base to near apex; anterior margin lightly emarginate in middle and rounded on each side. *Clypeus* large; anterior margin widely subemarginate, a strong puncture near each anterior angle. *Mandibles* stout, not long, without a seta in outer scrobe. *Mentum* deeply excavate, with broad prominent median tooth; sinus with sides parallel. *Palpi* stout: *labial* with penultimate joint a little longer than apical, 2-setose in front; apical joint club-shaped, shortly and roundly angustate-truncate: *maxillary* long; second joint longest (1 mm.); two

shorter (0·7 mm.), equal; apical truncate. *Maxillæ* obe longer than inner, 2-articulate; inner lobe stout, pex, inner side closely beset with bristles. *Ligula* ous, with two widely placed setæ at apex. *Prothorax* three or four widely placed setæ along lateral margins, seta near edge of explanate margin just before basal *ytra* widely oval, strongly punctate-striate, not base; margin interrupted and with an internal plica short striole at base of first interstice. *Body* sub-; scutellum wide. *Abdomen* with a strongly raised along anterior margin of segments 4-6; first segment asternum and dividing posterior coxæ. *Prosternum* oxal part wedge-shaped; posterior declivity narrow, *esosternum* with intercoxal declivity deeply excavate, l-like ridge on each side. *Legs* stout; tibiæ wide at or with inner side emarginate before apex, inner emargination; tarsi of moderate length, fifth joint eath.

CUNEIPECTUS FRENCHI, n.sp.

ide, oval, glabrous; black. Prothorax transverse); apex truncate behind head; anterior angles shortly ide, roundly obtuse; sides rounded, more gently base than to apex; base wide, truncate across sal angles produced shortly backwards, obtuse; disc liculate, transversely striolate; posterior marginal er near edge at a little distance (1 mm.) from basal r wide with edge thick, produced at anterior and Elytra wide, oval (19 × 12·6 mm.); shoulders apex wide, strongly sinuate on each side; disc wide, , hardly declivous to base behind scutellum, but n each side of base; striæ deep, coarsely punctate; ide, lightly convex, seventh more raised, subcosti- g outer margin of disc; space between summit of tice and lateral border depressed, rugose-punctate. readth 12·6 mm.

A.: Norseman District (Coll. French; unique).

There is a row of closely placed deep punctures near the la
border of the elytra, but these are not the normal setig
punctures of the ninth interstice; the latter are very smal
may be noticed by a careful inspection about the middle c
lateral depression.

The facies of this strange insect, for which I have not
founded a new genus, but have also felt compelled to pro
new tribe, is almost that of a true *Carabus*, and is very u
that of any other Australian carab. Most of its chara
show an affinity to the Trigonotomini, but it seems also to
some remote affinities towards the *Broscini*, *Chlæniini*
Panageini. It is evidently an ancient and generalised
such as might have been expected to be still in existen
Australia.

Tribe TRIGONOTOMINI.

Castelnau, Etudes Entomologiques, 1834, p.75.

Under the law of priority, which acts in the same mann
higher groups as it does for genera and species, the tribal
Trigonotomini must be given preference over Pterost
(Erichson, 1837) and Platysmatini (Tschitschérine, 1899).

Genus CASTELNAUDIA.

CASTELNAUDIA sp., Tschitschérine.

Trichosternus opacipennis Tschitschérine, Hor. Soc. Ent.
xxxv., 1902, p. 528 (not *Homalosoma opacipenne* Macleay).

There can be no doubt but that the late M. Tschitschérin
took another species for *Homolosoma opacipenne* Macl.; it
have been impossible for a specialist holding the views he c
taxonomy to have placed that species in the genus *Trichost*
One has only to take note of his statement in regard t
species he had before him, "tête et pronotum luisants,"
convinced that it was not *H. opacipenne* Macl., which has
the head nitid, the pronotum being opaque.

Tschitschérine's species is sufficiently described to be iden
It is unknown to me in nature; and "a specific name whic
doubtedly rests upon an error of identification can not be ret
for the misdetermined species even if the species in questio

afterwards placed in different genera" (Art.31, Internat. Rules Zool. Nomencl.). Tschitschérine gives the dimensions as length 25, prothorax 5·25 × 7, elytra 13 × 8·5 mm. His notes indicate that it is closely allied to *C. wilsoni* Casteln., from which it differs by its colour wholly black.

Genus Notonomus.

Notonomus carteri, n.sp.

Oval, robust. Head small (2·5 mm. across eyes); prothorax subcordate, basal angles obtuse, marked, posterior marginal seta just before basal angle in marginal channel; elytra oval, deeply striate; interstices convex, third interstice 3-punctate on apical two-thirds, humeral angles rounded. Black; elytra in ♂ subviridescent on apical and lateral declivities; legs piceous, tibiæ, tarsi and antennæ reddish-piceous.

Head convex; eyes round, prominent. Prothorax a little broader than long (3·5 × 3·7 mm.), lightly convex, widest before middle; sides lightly rounded, obliquely narrowed to base; apex truncate (2·5 mm.); anterior angles subprominent; base narrower than apex (2·3 mm.), sloping forward on each side; basal angles obtuse but marked; lateral border narrow, subsinuate just before base; median line well marked; lateral basal impressions wide, elongate, rather deep; space between them convex. Elytra oval (8 × 4·9 mm.), convex; apical sinuosities distinct, wide; basal and lateral borders meeting at humeral angles without interruption; eighth interstice rather narrow, but wider than ninth; tenth interstice shortly developed before apical sinuosities. Intercoxal declivity of prosternum rounded, of mesosternum decidedly concave. Length 13, breadth 4·9 mm.

Hab.—N.S.W.: Mount Kosciusko (Colls. Carter and Sloane).

Taken by Mr. H. J. Carter, to whose good nature I owe two specimens (♂♀). It has a considerable resemblance to *N. howitti* Sl., but differs by head smaller, less convex; prothorax narrower, particularly at base, more convex, not depressed between lateral basal impressions, lateral border narrower, especially near basal angles; intercoxal declivity of mesosternum decidedly concave. Its position in the genus is beside *N. muelleri*

Sl., from which it is readily distinguished by smaller size, narrower form; head smaller; eyes more roundly prominent; prothorax more narrowed to base, border subsinuate just before basal angles and continuing on to base at each side; legs darker; elytra with a subvirescent tinge in ♂, &c.

NOTONOMUS ÆQUALIS, n.sp.

Elongate-oval, convex. Prothorax subquadrate, posterior angles wide, hardly marked; elytra oval, strongly striate, humeral angles rounded (but basal border decidedly raised above lateral border at point of junction), interstices convex, third 4-punctate. Black, nitid; prothorax becoming metallic-green towards sides and across apex.

♂. Head moderate (3·3 mm. across eyes); eyes protuberant, deeply inclosed in large orbits posteriorly. Prothorax broader than long (4·5 x 4·9 mm.), widest a little before middle, very lightly narrowed to base; apex and base of equal width (3·6 mm.); sides lightly rounded; basal angles widely obtuse, marked by the posterior marginal seta on border; lateral border narrow, passing round basal angles on to sides of base; median line strongly impressed; lateral basal impressions wide, deep. Elytra oval (9·2 x 5·5 mm.), convex; apex widely sinuate on each side; tenth interstice short, well developed towards apex; interstices convex, subcarinate on apical declivity, eighth wider than ninth on basal half. Intercoxal declivity of prosternum rounded in middle, of mesosternum widely and very lightly concave. Length 16-18, breadth 5·5-6·3 mm.

Hab.—N.S.W.: Verona (Colls. Sloane and Taylor).

Given to me by Mr. F. H. Taylor of Sydney as coming from Verona in the Bega district of N. S. Wales. It has the facies of *N. spenceri*, but is allied to *N. macoyi* Sl.,* from which it differs by colour not wholly black; prothorax more convex, more evenly

* An error occurs in my description of *N. macoyi* where the size of the head is given as "4·1 mm. across eyes"; it should be 3·1 mm. from a remeasurement of the type still in my possession.—T.G.S.

rounded on sides, less strongly narrowed to base, posterior angles wider and less marked; elytra with basal border more decidedly raised above lateral border at shoulders, inner interstices more raised and narrower at apex; legs black, &c.

Notonomus violaceus Castelnau.

Trigonotoma violacea Cast., Etud. Ent. 1834, p.76; *Notonomus fletcheri* Sl., Proc. Linn. Soc. N. S. Wales, 1902, xxvii. p.277.

M. Petri Semenow of St. Petersburg has communicated to me a MS. description of *Trigonotoma violacea* Cast., by the late M. Tschitschérine, from which I have been able to determine it without doubt as the Sydney form of *N. fletcheri* Sl. M. Tschitschérine's note indicated that one of the specimens before him (belonging to the Paris Museum) was ticketed "Sydney." My description of *N. fletcheri* was founded on the form found at Springwood, which has the head and prothorax of a cupreous colour, elytra with a dark cupreous tinge. I believe that it will be found advantageous for collectors to retain this name for the mountain form or variety of *N. violaceus* Cast.

Notonomus johnstoni, n.sp.

♀. Elongate-oval. Prothorax subcordate, posterior angles not marked, posterior marginal seta distant from base; elytra oval, deeply striate; interstices convex, third 3-punctate, eighth narrow. Black with a very obscure bronze tint on elytra.

Head rather large (3·3 across eyes), oval, convex; eyes reniform, subprominent. Prothorax broader than long (4 × 4·4 mm.), widest before middle, narrower at base (2·7 mm.) than at apex (3·3 mm.); sides rounded, roundly-obliquely narrowed to base; apex truncate; basal angles not marked, very near peduncle; lateral border narrow, very narrow behind posterior marginal puncture; median line well marked; lateral basal impressions near basal angles, shallow, wide. Elytra oval (9·5 × 5·5 mm.), convex; basal and lateral borders meeting without interruption at humeral angles; apex widely rounded with a light wide

sinuosity on each side. Intercoxal declivity of prosternum rounded in middle, of mesosternum flat. Length 16·5, breadth 5·5 mm.

Hab.—N.S.W.: Barrington River (Colls. Sloane and Taylor; taken by Mr. S. J. Johnston).

I owe a specimen of this species to the kindness of Mr. F. H. Taylor of Sydney. It is most nearly allied to *N. excisipennis* Sl., but is differentiated by colour; elytra not deeply sinuate on each side of apex; posterior marginal seta of prothorax more distant from base, &c. The convex narrow eighth interstice is not wider than ninth, except just near the base, but it is not so linear as in *N. excisipennis*. *N. johnstoni* has almost exactly the facies of *N. scotti* Sl., from which it may be distinguished at once by the narrower eighth interstice, posterior marginal seta of prothorax 0·75 mm. from basal angle, not at basal angle, &c.

NOTONOMUS SCOTTI, n.sp.

N. kingi Sl. (not Chaudoir), Proc. Linn. Soc. N.S. Wales, 1902, xxvii. p.286.

I have no doubt but that the late M. Tschitschérine was right in considering *N. excisipennis* Sl., as synonymous with *N. kingi* Chaud.,* specimens of which he saw in the Paris Museum; this leaves the species which I have regarded as *N. kingi* without a name; *N. scotti* is now proposed to replace *N. kingi* Sl., my description of which is sufficient for purposes of recognition. It seems fitting to associate this species with the name of the late A. W. Scott, the well known naturalist, formerly resident at Ash Island, where this species is plentiful.

NOTONOMUS SÆPISTRIATUS, n.sp.

Robust, oval; elytra with twelve interstices. Upper surface bronzy, submetallic, brighter towards sides of prothorax and elytra; under surface and legs black, or piceous-black.

* It is doubtful whether Chaudoir considered he was redescribing *Pœcilus kingi* W. S. Macleay, or not; but I believe not. If *P. kingi* W. S. Macleay, be taken to be a *Notonomus*, then *N. kingi* Chaud., will be a *nom. præoc.* and *N. excisipennis* must stand; for this reason I do not propose to replace *N. excisipennis* Sl., by *N. kingi* Chaud.

rge (3·3 mm. across eyes), strongly bi-impressed between Prothorax transverse (3·8 x 5 mm.), wider at base an at apex (3·4 mm.), depressed; sides arcuate, shortly just before base; basal angles subrectangular, obtuse ; border narrow towards apex, wide towards base; marginal puncture on border at basal angle; median ly impressed; lateral basal impressions short, foveiform, rginal channel by a narrow impression posteriorly. ncate-oval (9 x 5·6 mm.), deeply striate; twelve convex s undulate interstices on each elytron, first bearing a striole at base, second catenulate on apical declivity, nctate on apical half, costiform behind second puncture, ery narrow, seriate-punctate, twelfth linear, extending r half the length of elytra; basal border raised and entate at humeral angles. Intercoxal declivity of flat, of mesosternum wide, not concave. Ventral nitid, punctate laterally. Length 14·5-16·5, breadth .

♀. : Atherton.

cimens (♂♀) of this remarkable species occurred to me rub at Atherton on the upper waters of the Barron rth Queensland, in June, 1906. Its position is near *asiæ* Dej., though probably it has more affinity to *riatus* Sl., than to any other described species. The e interstitial sculpture of the elytra differentiates this m all others hitherto described. If the interstices at re counted, ten will be found (ninth seriate-punctate), he normal number in *Notonomus*, but towards the base welve (eleventh seriate-punctate); the two extra inter- ult from the seventh interstice branching into three of normal width a little before the apex.

NOTONOMUS KINGI W. S. Macleay.

kingi W. S. Macleay, King's Survey, 1827, ii. p.438.
cription of *Pœcilus kingi* W. S. Macleay, is brief and he extreme, not even the size being given, so that it

is impossible to know from it even the genus to which it sho be referred; its identification would be absolutely imposs were it not that Castelnau in his "Histoire Naturelle des Inse Coléoptères," I. (p.105), supplies a clue when he says of his *Pœc marginatus* (= *Notonomus marginatus*) at the end of the desc tion :—"*Il est voison du P. Kingii* Macleay." If we accept clue it appears to me that we must consider *P. kingi* W Macleay, to be a species of *Notonomus*, and judging from description it should be, in all probability, the species w Chaudoir afterwards named *N. incrassatus*, though I do not to assume that this suggestion of mine finally settles question that these two names are synonyms, but it will serv keep the subject before the minds of other investigators.

NOTONOMUS MINIMUS, n.sp.

Elliptical. Prothorax cordate, posterior marginal seta border at basal angle; elytra strongly striate, basal border tate at shoulders, third interstice bipunctate, eighth inter narrower than ninth; intercoxal declivity of prosternum fla mesosternum wide, not convex; tarsi with onychium glab beneath. Black, legs and antennæ piceous-red.

Head oval, convex (1·8 mm. across eyes), smooth, very fe bi-impressed between antennæ; eyes (with orbits) renif rather prominent. Prothorax convex, cordate, broader long (2·3 x 2·65 mm.), widest before middle; sides lightly roun shortly sinuate before base; apex (1·8 mm) narrower than (2·15 mm.); basal angles rectangular with summit obtuse; la border narrow, reflexed; median line deeply marked, not reac base; lateral basal impressions deep, narrow. Elytra (5·2 x 3·3 mm.), lightly and evenly rounded on sides, narrowe base; apex obsoletely sinuate on each side; striæ deep; inters convex, eighth narrow (narrower than ninth), tenth short (noticeable just before lateral apical sinuosities). Lengt breadth 3·3 mm.

Hab.—Vict.: Bright (C. French, Junr.; Coll. Sloane; specimens).

Very distinct, being by far the smallest species of the genus; I have seen no other species of *Notonomus* less than 12 mm. in length; it has the facies of a small specimen of *Rhytisternus miser* Chaud. According to the classification adopted in my "Revision" (1902) its place is next *N. incrassatus* Chaud.

NOTONOMUS AUSTRALIS Castelnau.

Trigonotoma australis Castelnau, Hist. Nat. Ins. i. p. 120 (1840).

I believe that *Trigonotoma australis* Cast., (which is not indexed in Masters' Catalogue; nor have I found it in Gemminger & Harold's Catalogue) is a species of *Notonomus*, and that the species afterwards described by Chaudoir as *N. æneomicans* is conspecific with it. The only discrepancy would be that Castelnau described the elytra of *T. australis* as having three punctures on the third stria, whereas in *N. æneomicans* there are four or five; but Castelnau had formerly (1834) described *N.* (*Trigonotoma*) *violaceus* as having two punctures on the third interstice, though in reality there are three or four, so that it is evident he did not take care to be thoroughly accurate in this matter. It might be thought that *T. australis* Cast., was *N. colossus* Sl., but Castelnau's statement *under surface and legs black* applies to *N. æneomicans* rather than to *N. colossus*, the latter having the legs piceous with the tarsi reddish. Though I hold the view that *Notonomus australis* Cast., will likely ultimately supplant *N. æneomicans* Chaud., yet the species is a variable one with a wide distribution, which will probably be found to include several varieties entitled to names; so that I do not feel certain that the name *N. æneomicans*, which I consider to belong to the form found in South Queensland, may not be capable of retention, at least for a variety.

Castelnau's "Historie Naturelle des Insectes Coléop." is a work hardly to be seen in Australia; therefore, that other students may be able to weigh the evidence, I reproduce the description:—

"*Trigonotoma australis*. Long. 9 lig. Larg. 3 lig.—D'un noir luisant; tête un peu bronzée, avec deux impressions entre les

yeux; corselet en coeur, rebordé latéralement, avec une ligne longitudinal au milieu, et deux traits au bord postérieur, d'un vert brillant, un peu bronzé au milieu, elytrées bronzées, ovales, striées, avec trois points sur la troisième strie, le bord extérieur d'un vert éclatant; dessous du corps et pattes noirs. Nouvelle-Hollande. Collection de M. Gory."

Genus SETALIMORPHUS.

SETALIMORPHUS NANUS Sloane.

Proc. Linn. Soc. N. S. Wales (2) ix., 1894, p.435; *Phænaulax stenomorpha* Tschitschérine, Hor. Soc. Ent. Ross. xxxii. 1898, p.167.

The late M. Tschitschérine had recognised his genus *Phænaulax* as synonymous with *Setalimorphus*;* and a comparison of specimens of *S. nanus* with the description of *Ph. stenomorpha* convinces me that they are the same species. I am not, however, convinced that *Phænaulax* is absolutely congeneric with *Setalimorphus*; points of difference being the presence of a setigerous puncture at the basal angles of the prothorax, and two foveiform punctures on the apical ventral segment in *S. punctiventris* Sl. (the type-species of the genus), characters which are not found in *S. nanus* Sl. My present conclusion is that while Tschitschérine's genus *Phenaulax* is likely to obtain ultimate recognition as valid, the species on which it is founded must be considered a synonym of *Setalimorphus nanus* Sl.

RHYTISTERNUS LÆVIDORSIS Tschitschérine.

Hor. Soc. Ent. Ross. xxv. 1891, p.169.

In these Proceedings (1894 p.410) I published the opinion that *Rhytisternus lævidorsis* Tschits., was synonymous with *R.* (*Pœcilus*) *lævis* Macl., but having recognised a species sent to me by Mr. F. P. Dodd from Townsville, Queensland, as *R. lævidorsis*, I have no doubt but that it is a good species, thoroughly distinct from *R. lævis*. In *R. lævidorsis* the posterior angles of the pro-

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* Hor. Soc. Ent. Ross. xxxv. p.508 (1902).

thorax are described as more rounded at the summit than in *R. liopleurus* Chaud., whereas in *R. lævis* these angles are more rectangular and marked than in *R. liopleurus*.

LOXOGENIUS, n.gen.

Mentum short; sinus shallow, wide, bordered and roundly advanced at bottom; lobes obtusely rounded at apex, oblique on inner side. *Submentum* raised above mentum, with about six setigerous punctures on each side; a wide deep concavity behind middle of submentum. *Mouth-parts* similar to those of *Castelnaudia*; labial palpi with penultimate joint 2-setose. *Labrum* prominent, 6-setose, lightly and widely emarginate. *Paragenæ** with upper margin forming a border, a deep elongate subfoveiform depression between this upper border and a median ridge. *Prothorax* opaque, subcordate; lateral channel and border wide; a lateral seta on each margin at widest part; two lateral basal setæ on each side behind posterior sinuosity; two setæ on margin at each anterior angle. *Elytra* convex, a little narrowed to base, opaque; ninth interstice and lateral margin nitid; basal border nitid, with a strong obtuse tooth at each humeral angle closing the space between the second carina and the lateral margin; third, fifth and seventh interstices strongly carinate. *Prosternum* with a median channel extending backwards from about anterior third almost to base; intercoxal part bordered on base and bearing three or four setæ. *Mesosternum* with intercoxal declivity glabrous. *Metasternum* glabrous; episterna concave, short, but together with epimera, longer than broad. *Ventral segments* transversely sulcate and bordered posteriorly; apical segment in ♂ with two, in ♀ with four, setigerous punctures. *Facies* of *Castelnaudia*. Apterous. ♂. *Anterior tarsi* with three basal joints dilatate and with squamulæ beneath.

Type.—*Homalosoma opacipenne* Macleay. Length 20, prothorax 5 × 6, elytra 10·7 × 6·3 mm. Several specimens sent to

* Chaudoir gave the name *paragena* to the space between the subocular antennal scrobe and the buccal fissure.

me by Mr. F. P. Dodd from Kuranda, Queensland, have been compared with Macleay's type in the Macleay Museum.

This species evidently never came under the observation of the late M. Tschitschérine;* I regard it as a primitive form apparently more allied to Tschitschérine's genus *Liopasa*† than to any other described form.

Genus Setalis.

Setalis rubripes, n.sp.

Oblong, oval, robust. Head small (1·4 mm. across eyes), front strongly bi-impressed; eyes hemispherical, distant from buccal fissure beneath; prothorax convex, deeply bi-impressed on each side of base; two marginal setæ on each side, anterior seta at anterior third, posterior near basal angle at inner side of lateral channel; elytra convex, strongly crenulate-striate, without scutellar striole, third interstice impunctate. Black; legs, antennæ, and mouth-parts red.

Prothorax subcordate (1·8 x 2·3 mm.), widest about middle, wider at base (2 mm.) than at apex (1·4 mm.); sides arcuate, lightly narrowed to base; apex lightly emarginate, angles obtuse; base emarginate in middle; basal angles subrectangular (obtuse but marked); lateral border narrow; marginal channel narrow, ending abruptly just before base; median line lightly marked on disc; inner lateral basal impression deep, short, sulciform, not reaching base; inner basal impression forming a shallow oblong fovea. Elytra oval (4 x 2·7 mm.), convex, declivous to base; striæ deep, crenulate; interstices convex, sixth and ninth contiguous near apex, seventh wide and well developed on basal two-thirds, eighth only developed (and linear) on basal third, ninth seriate-punctate; basal border forming a short strong tooth at humeral angles; apex sinuate on each side. Metasternum very short and bearing about three fine punctures on each side

* *Vide supra* under *Castelnaudia* sp. p. 360.

† Mr. H. J. Carter recently found *Liopasa crepera* Tschitsch., on the Tweed River, N.S.W.; its exact habitat has not been recorded before. It resembles *Notonomus angustibasis* Sl., in facies and striation of elytra.

-mediate and posterior coxæ, episterna short. Basal
ents bearing some punctures, three apical segments
ersely sulcate and with a deep fovea on each side,
t with two foveiform punctures. Length 7, breadth

Atherton. One specimen occurred to me in thick
e, 1906.

ent from *S. niger* Cast., (the other species of the
) from which it is easily distinguished by its smaller
r and more convex form, very differently shaped
ytra with striæ crenulate, &c. It is remarkable that
isual conformation of the lateral elytral interstices
in two such very different species as *S. niger* and
In my description of *Loxogmus obscurus* (= *S. niger*
e said the *eighth* elytral interstice is punctate, having
ie true eighth interstice, which only shows in a linear
e base. In *S. niger* the seventh interstice also dis-
t the posterior third, so that the sixth and ninth
ecome contiguous near the apex as in *S. rubripes.*

COSMODISCUS, n.gen.

ot deeply excised; lobes obtuse at apex; sinus oblique
iort wide triangular median tooth at bottom. *Palpi*
with penultimate joint bisetose; apical joint short,
r than penultimate; compressed, truncate: *maxillary*
oint short, hardly longer than penultimate, obtuse at
um shagreened, truncate, sexsetose. *Mandibles* short,
ta in outer groove. *Clypeus* bisetose. *Head* small;
and shortly bi-impressed : *eyes* hemispherical, nar-
ted from buccal fissure beneath. *Antennæ* short,
lightly incrassate; joints 1-3 glabrous, 6-11 com-
large, about as long as second and third together,
test. *Prothorax* widely transverse, wider at base
an at apex (2 mm.); basal angles obtuse; apical border
narginal setæ on each side, anterior just before middle,
basal angle. *Elytra* bordered on base, not dentate

at humeral angles; apex sinuate and with margin interrupted by an internal plica on each side; interstices convex, without a basal striole on first or second, third impunctate. *Prosternum* lævigate, bordered between coxæ; episterna finely shagreened. *Mesosternal episterna* densely punctate. *Metasternum* on each side, and episterna densely punctate. *Ventral segments* not transversely sulcate, densely punctate, except in middle between ambulatorial setæ. *Legs* short: femora short; anterior tibiæ with apex wide, rounded and spinose externally; tarsi short, glabrous on upper surface, onychium glabrous beneath, ungues simple; anterior tarsi with first joint about as long as three succeeding joints together, strongly produced at apex internally in an elongate spiniform process, joints 2-4 successively shorter, second with apex sharply produced internally; posterior tarsi slender, first joint about as long as three succeeding joints together, these successively shorter, fourth very small; posterior trochanters with a setigerous puncture near base.

The position of this genus is evidently near *Stomonaxus*, which is unknown to me in nature; it differs from Motschulsky's description of the genus *Stomonaxus* by mandibles short, first joint of antennæ longer than third; I believe, too, that the form of the prothorax (shaped somewhat like that of *Æphnidius*, lateral basal impressions feebly marked, base wide and obtusely angled) is altogether different from the form of the prothorax in *Stomonaxus*.

COSMODISCUS RUBRIPICTUS, n.sp.

Piceous-black; prothorax with border testaceous; elytra with ferruginous pattern (ferruginous pattern reaching the fourth interstice at base, spreading over the three outer interstices on the middle of the sides, sending off a wide oblique uneven fasciaform branch inwards on each elytron to join the corresponding branch of the other elytron at the suture about apical third), lateral channel testaceous backwards to apical sinuosity, inflexed margin ferruginous, infuscate opposite metepisterna; coxæ, middle of metasternum, mesosternum, prothorax, and under parts of head

ferruginous; femora and posterior trochanters testaceous; tibiæ and tarsi reddish-piceous; antennæ ferruginous, paler near base, infuscate towards apex. Prothorax transverse (1·7 x 3 mm.), depressed on disc and across base, lightly declivous to sides on anterior two-thirds; apex lightly emarginate; anterior angles obtuse, not prominent; sides lightly rounded; basal angles obtuse; base lightly sinuate-truncate in middle between lateral basal impressions, sinuate on each side; border entire on apex, rather wide on sides, obsolete just before basal angles; median line hardly marked; lateral basal impressions linear, short, shallow, punctulate. Elytra widely ovate (4·8 x 3·7 mm.); shoulders rounded; interstices convex, narrower and more raised at apex. Length 7·7, breadth 3·7 mm.

Hab.—Q.: Kuranda (Dodd; Coll. Sloane; unique).

Tribe LEBIINI.

Genus PHLŒODROMIUS.

PHLŒODROMIUS PLAGIATUS Macleay.

This species, described from Yule Island, New Guinea, is here recorded from Australia for the first time. It is at once distinguished from *Ph. piceus* Macl., the only other species of the genus, by the large black patch common to both elytra which extends from about the basal third to the apical fifth and reaches laterally to the ninth interstice, but not to the border. Length 9, proth. 1·5 x 2, el. 5 x 3·5 mm.

Hab.—Q.: Townsville and Kuranda (Dodd; Coll. Sloane).

Note.—In the genus *Phlœodromius* the mesosternum is small and narrow between the intermediate coxæ, and the metasternum meets it by a very narrow intercoxal prolongation; the tarsi have all the joints clothed beneath with chestnut-coloured hairpads; in the male two narrow rows of paler squamulæ are noticeable in the middle of joints 1-3 of the anterior tarsi, and the third joint of the intermediate tarsi; the third interstice of the elytra is 3-punctate, the anterior puncture is near the base beside the third stria, the second puncture a little before the middle near

the third stria, the third puncture about the apical fifth near the second stria. The ungues are strongly pectinate.

SAROTHROCREPIS MUCRONATUS, n.sp.

Head large (2 mm. across eyes); prothorax transverse, base wide, lobate; elytra wide, strongly striate, third interstice bi-punctate near course of third stria, each elytron with a short spiniform process at outer and inner angle of apical truncature; legs as in *Sarothrocrepis*; tarsi with penultimate joint deeply emarginate, ungues strongly pectinate. Dark piceous; prothorax with explanate margins testaceous; elytra with reflexed border and marginal channel ferruginous; under surface of prothorax, mesothorax, metathorax, inflexed margins of elytra and femora pale testaceous; abdomen piceous, lighter-coloured near posterior coxæ; tarsi, antennæ, and palpi ferruginous.

Head convex between eyes, not narrowed behind eyes; upper surface distinctly punctate; front and clypeus rather rugulose; eyes very large and prominent. Antennæ slender, inserted close to eyes, three basal joints glabrous. Prothorax transverse ($1 \cdot 85 \times 2 \cdot 8$ mm.); apex truncate, same width as neck; sides roundly ampliate from apex without marked anterior angles, attaining greatest width and rounded about middle, very little (roundly) narrowed to base; basal angles strongly marked, rectangular but not acute, bearing a setigerous puncture; disc convex; lateral margins explanate, very wide at base, becoming narrow near apex; base truncate on each side of peduncle (behind testaceous explanate margin), middle rather strongly produced backwards and forming a well marked wide lobe; sinuosity on each side of basal lobe wide but decidedly marked. Elytra wide ($6 \cdot 5 \times 4 \cdot 5$ mm.), widest behind middle, convex; base widely rounded on each side of peduncle; striæ strongly impressed, finely crenulate at bottom, seventh ending near suture in an ocellate setigerous puncture opposite apical extremity of third interstice; interstices convex, four inner ones not convex—except towards base, first narrow, ending at apex in a short mucro, becoming wider and bearing an elongate strongly im-

pressed striole on basal fifth; interstices 5-7 strongly convex, ninth wide (wider than eighth), seriate-punctate; space between eighth stria and margin very wide near apex; border narrowly reflexed on sides, feeble on base near scutellum; apical truncature sloping lightly obliquely forward from suture to extremity of eighth interstice, then curving very lightly backwards to the sharply marked external angle. Length 10·5, breadth 4·5 mm.

Hab.—Q.: Townsville (Dodd).

I have placed this species in *Sarothrocrepis*, at least provisionally, on account of its evident affinities to that genus, though it differs from all the other species by the punctures of the third elytral interstice; the apical truncature of each elytron dentate at outer and inner angle; the elytra with deeply impressed striæ; interstices 4-6 strongly convex near base, ninth as wide as eighth; the abdomen setigero-punctate. It is also isolated by its dark colour (elytra not widely margined with yellow).

Genus EULEBIA.

EULEBIA BICOLOR, n.sp.

Testaceous; elytra with a very broad dark blue fascia (almost two-thirds of elytra) across middle from side to side; antennæ after third joint infuscate.

Head nitid, minutely punctulate; eyes black, very prominent, globular. Prothorax transverse, a little wider than head (1 × 1·5 mm.); sides roundly narrowed anteriorly, oblique posteriorly; base much wider than apex, truncate on each side of peduncle, median part produced backwards, rounded; anterior angles widely rounded; basal angles subrectangular, obtuse at summit; lateral margins explanate, very wide posteriorly; two marginal setigerous punctures on each side, anterior at widest part, posterior on border at basal angle. Elytra wide (4 × 2·9mm.), finely striate; interstices a little convex, shagreened, minutely punctulate, first with a fine striole at base, third 3-punctate, anterior puncture just outside anterior margin of blue part, second at its posterior margin, third at apex of interstice; blue

area having anterior margin a little sinuate, the testaceous colour of the base extending back a little along the fourth interstice; anterior margin of apical testaceous area extending forward from outer apical angle to second puncture of third interstice, then running back a little towards suture. Ungues serrate. Length 5·3, breadth 2·9 mm.

Hab.—Q.: Kuranda (Dodd; "on flowers of Eucalyptus"; Coll. Sloane).

The three known species of *Eulebia* are before me; they may be distinguished from one another as under:—

Elytra bicolorous on disc. Testaceous with four inner interstices black on disc	*E. plagiata* Macl.
Elytra bicolorous on disc. Blue with base (widely) and apex testaceous	*E. bicolor* Sl.
Elytra unicolorous—brownish	*E. picipennis* Macl.

Note.—*Eulebia* is closely allied to *Sarothrocrepis*; in fact it seems to me rather a section of *Sarothrocrepis* than a distinct genus.

Genus Coptodera.

Eucalyptocola Macleay.

The three Australian species of *Coptodera* may be tabulated as under:—

Prothorax with lateral margins wide.	
Elytra piceous-black, with a narrow zigzag, or V-shaped ferruginous fascia on posterior half, sometimes with also a faint discal macula on each elytron in front of the fascia	*C. australis* Chaud.
Elytra piceous-black, with an intricate pattern in the form of two broken zigzag transverse testaceous fasciæ	*C. mastersi* Macl.
Prothorax with lateral margins narrow	*C. marcida* Blackb.

Coptodera australis Chaudoir.

Ann. Soc. Ent. Belg. xii., 1869, p.184. *Philophlœus dubius* Macl., Trans. Ent. Soc. N. S. Wales, ii., 1871, p.90.

I have determined *Philophlœus dubius* Macl., by examination of the type in the Australian Museum, and, after comparing

specimens in my possession with the description of *C. australis* Chaud., feel no doubt of the identity of these species. *Philophlœus dubius* Macl., is certainly congeneric with *C. elegantula* Schmidt-Goebel, from Burma, to which it is closely allied.

Hab.—Eastern Australia.—Q.: Atherton (Sloane); Kuranda (Dodd); Gayndah (Masters). — N. S. Wales: Tweed River (Carter); Richmond River (Helms).

Coptodera mastersi Macleay.

Eucalyptocola mastersi. Trans. Ent. Soc. N. S. Wales, ii. 1871, p.91.

This species is known to me, and is congeneric with *C. australis* Chaud. Macleay was in error in describing his genus *Eucalyptocola* as having the mentum with a "large acute median tooth." I have dissected the mouth-parts of *Eucalyptocola mastersi* Macl., and found the mentum with the sinus edentate. *C. mastersi* must be very near *Coptodera* (*Rhinocheila*) *levrati* Perroud, from New Caledonia.

Hab.—Q.: Kuranda (Dodd); Gayndah (Masters); Brisbane (Hacker).

Coptodera marcida Blackburn.

Eucalyptocola marcida Trans. Roy. Soc. South Aust. 1903, p.91.

This species is unknown to me in nature. I have placed it in the table above by the aid of the description, which leaves us in some doubt as to whether it is actually congeneric with *C. australis* Chaud., or not.

Hab.—Vict.: Glenelg River (Blackburn).

Genus Moctherus.

Moctherus macleayi, n.sp.

Oval; elytra strongly and simply striate; prothorax deeply emarginate at apex, widely margined on sides, base truncate; mentum edentate. Black; elytra with four round testaceous spots, anterior near each shoulder on interstices 4-8, posterior at apical fourth on interstices 3-6; under surface piceous; legs and middle of abdomen brownish.

Head convex (1·1 mm. across eyes), shagreened; front not impressed; eyes convex, prominent, coarsely faceted. Prothorax wider than head, transverse (0·9 x 1·5 mm.), widest and subangulate in middle; disc convex, canaliculate; sides obliquely narrowed to apex and base, a little more strongly and roundly so to apex; anterior margin finely bordered; anterior angles obtuse, rather distant from head; base truncate, slightly oblique on sides; basal angles obtuse but marked; lateral margins reflexed, explanate (widely so posteriorly), bearing two setæ (anterior at middle, posterior at basal angle); basal area depressed. Elytra widely ovate (3·2 x 2·35 mm.), lightly convex; humeral angles widely rounded; apex obliquely truncate; external angle widely rounded, sutural angle decidedly marked; interstices lævigate, subconvex, first with a short striole at base, third with a fine puncture on subapical macula, ninth not narrower than eighth, seriate-punctate; marginal channel wide, depressed; border extending from peduncle to apical sutural angle. Mesosternum with intercoxal part small, narrow; metasternum meeting mesosternum in a narrow point between the coxæ. Tarsi with penultimate joint entire. Length 4·5-5, breadth 2·35 mm.

Hab.—Q.: Cairns District (Froggatt); Normanby River (Sloane).

I have been able at the Macleay Museum to compare specimens brought from the Cairns District by Mr. Froggatt in 1887 with *M. tetraspilotus* W. S. Macleay, and have found that *M. macleayi* differs by size smaller; prothorax shorter, wider, sides not sinuate posteriorly; head less rugulose, &c. Several specimens occurred to me on the Upper Normanby River, 40 miles south-west of Cooktown, in June, 1906, beneath a log upon the ground in scrub. The genus *Moctherus* has not been recorded previously from Australia.

STRICKLANDIA NIGRA, n.sp.

Depressed; head large, eyes prominent; prothorax deeply emarginate at apex, lateral margins explanate; elytra much wider than prothorax, striate, interstices subcostate, a sharp spine at inner and outer apical angles of each elytron. Black;

-face piceous; tarsi, palpi, and six apical joints of reddish, four basal joints of antennæ piceous. ...arge (2·5 mm. across eyes), strongly obliquely and evenly behind eyes, subconvex between eyes, widely and feebly on each side between antennæ; eyes large, hemi- not inclosed at base, very close to buccal fissure beneath; runcate; labrum long, almost covering mandibles, runcate and 6-setose at apex (the lateral setæ long). with a short, widely obtuse prominence in middle of abial palpi with apical joint elongate; penultimate rter, bisetose in front. Antennæ slender; basal condyle Prothorax broader than long (1·8 [2·2 at sides] × 2·85 est and subangulate just before middle; sides narrowed in an oblique curve, more lightly and subsinuately to base; apex deeply and roundly emarginate; anterior minent, obtuse; base truncate; basal angles wide; disc te, transversely striolate; margins explanate, widely widest at basal angles; a wide round depression near l angle, these depressions connected by a rather wide impression; a setigerous puncture on edge of explanate basal angle, and another at widest part of prothorax on a few fine setæ on margin near each anterior angle. htly convex, shortly ovate (6·5 × 4·8 mm.), about twice as ase as the base of the prothorax; humeral angles widely apical truncature of each elytron obliquely arcuate, a e spine at outer angle; a long acute spine at apex of terstice; striæ finely punctate; interstices convex or e, with a row of minute punctures down middle, third distinct setigerous punctures about apical third, ninth nctate, narrow and catenulate near shoulders; border reflexed on sides, reaching peduncle; inflexed margin r base. Prosternum with intercoxal part narrow, on each side; mesosternum narrow between coxæ; meta- neeting mesosternum between middle coxæ in a sharp arsi long, slender; three basal joints of anterior in male nflated; ungues finely pectinate near base. Length 11, ·8 mm.

Hab.—Q.: Kuranda (Dodd; March and April).

I compared this species with the type of *S. pericalloides* Macl., in the Australian Museum and found it thoroughly distinct. It differs decidedly from *S. pericalloides* by the shape of the prothorax, which has the sides far less ampliate at middle, much less strongly sinuate posteriorly, and without the six or seven long marginal setæ of the anterior half; the anterior angles triangular, not obtusely rounded, &c. The New Guinea genus *Stricklandia* is now recorded for the first time from the Australian mainland.

Genus Scopodes.

Scopodes cyaneus, n.sp.

Upper surface bluish; elytra violaceous; legs testaceous. Head wider than prothorax (1·2 mm. across eyes), smooth, nitid; eyes large and prominent. Prothorax a little broader than long (0·75 x 0·9 mm.), convex, nitid, widest at anterior marginal seta (this on a sharp triangular process), narrowed and transversely impressed behind posterior marginal seta (this on a small angulate prominence a little before the base); lateral border reflexed between marginal setæ. Elytra oval (2·3 x 1·6 mm.), punctate-striate; interstices depressed, third without distinct discoidal punctures.* Length 4, breadth 1·6 mm.

Hab.—Q.: Kuranda (Dodd).

A distinct species. Its colour, the striæ of the elytra formed of rows of strong punctures, and the third interstice without foveiform punctures, are features that differentiate it from all the other Australian species. According to the table of the Australian species of Scopodes given by me in these Proceedings, (1903, p.637), it would be placed nearest *S. aterrimus* Chaud., and *S. sydneyensis* Sl., but it is not at all closely allied to these species.

Scopodes angulicollis Macleay.

Trans. Ent. Soc. N. S. Wales, ii., 1871, p.92; *S. rimosicollis* Sloane, Proc. Linn. Soc. N. S. Wales, 1903, xxviii., p.639.

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* In my unique specimen I am able to detect only one fine puncture, almost confused with the punctures of the third stria, placed about the anterior fourth.

npared my specimens of *S. rimosicollis* with the type *ollis* and found them the same.

Kuranda (Dodd); Gayndah (Masters)—N. S. W.: lms); Illawarra (Carter).

SCOPODES DENTICOLLIS Macleay.

t. Soc. N. S. Wales, i. 1864, p. 112; *S. sexfoveatus* c. Linn. Soc. N. S. Wales, (2), iii. 1888, p.456.

mined the types of *S. denticollis* and *S. foveatus* in Museum, and could find no difference between them.

SCOPODES LAEVIS Macleay.

. Soc. N. S. Wales, ii. 1871, p.92.

n the type of *S. laevis* in the Australian Museum, found it allied to *S. denticollis*, Macl. It has all necessary to bring it into the same group as *S.* cording to the tabular view of the species I have se Proceedings for 1893 (p.637). I also compared *lneyensis* Sl., and considered them distinct.

Genus ECTINOCHILA.

ECTINOCHILA AURATA Macleay.

uratus Macleay, Trans. Ent. Soc. N.S.Wales, ii. 1871, *chila tessellata* Chaudoir, Col. Nov. 1883, i. p. 21; *iolatus* Macleay, Proc. Linn. Soc. N. S. Wales, 1887

y recently been able to compare Chaudoir's descrip- *nochila tessellata* with fresh specimens of *Scopodes* l., with the result that I feel no doubt as to their ne types of *Scopodes fasciolatus* Macl., are in the seum, where are also specimens of *Scopodes auratus* h; a recent examination of these convinced me of y.

Kuranda (Dodd); Gayndah (Masters); Coomera, isbane (Sloane; under the bark of a dead sapling;

ON DIMORPHISM IN THE FEMALES OF AUSTRALIAN AGRIONIDÆ.

By R. J. Tillyard, M.A., F.E.S.

In the Proceedings of this Society for 1905 (p.302) I descri a dimorphic form of the female of *Ischnura heterosticta* Bu Since that time further examples of dimorphism have c to light, and the present paper is the outcome of the result my investigations in this direction.

Of all the genera comprising the Australian Agrionidæ, tl are only two in which I have been able to discover phenomenon of dimorphism. These two contain the smallest weakest species of the dragonflies known in Australia, a p which serves to strengthen the contention that the existence dimorphic females is in some manner or other connected with preservation of the species. The two genera in question *Ischnura* and *Agriocnemis*. Of the former, three species (*I. het sticta* Burm., *I. delicata* Selys, *I. senegalensis* Rambur) known to inhabit Australia. The case of *I. heterosticta* has b already dealt with. *I. senegalensis* I have never yet taken, its similarity to *I. heterosticta* leads me to believe that in

it is common, a careful search will reveal the
a dimorph. As regards *I. delicata*, this insect differs
in size and colouration from the other two; however,
lent that a dimorphic form would be found to exist.
e of its abundance all over the Eastern States, a
ch for many months failed to reveal the desired form.
during my trip to Western Australia, in January
was successful in discovering the dimorphic female.
nctly rare form, and where it occurs, it numbers only
of the females taken; whereas in the case of *hetero-*
dimorph occurs in every locality and is nearly as
the ordinary form.

ds the genus *Agriocnemis*, on account of the rarity of
species, my data are necessarily incomplete, but they
nt to show the existence of a series of dimorphic
different type from those of *Ischnura*. The dimorphs
a in Australia are male-mimicking, but in other
dimorphs of this genus have been recorded, known as
orms from their prevailing colour. The dimorphs of
s may also be classed as "orange" or "red" forms,
markable for showing not the slightest resemblance
e male or to the ordinary form of the female, so much
ome cases I have been for a long time deceived as to
y of the insect (see *Agriocnemis pruinescens* below).
is very incomplete in this genus, and in only one
e I found both forms of the female; but in the other
one form of female that is so far known to occur is
an ordinary form and sometimes an "orange" or
n. Hence I have arranged all the known females into
, feeling certain that, as in the case of *I. delicata*, a
rch for a second form of the female, where still
vill be well rewarded. There is of course also the
that amongst these extremely rare species of *Agrioc-*
of the two forms of female has already died out, thus
g the final demise of the species.

Genus Ischnura.

I. heterosticta Burm., possesses a well-developed dimorphic female, a complete mimic of the male. This form occurs in all localities where the ordinary form is found and is fairly common, comprising from 30-40% of all the females taken.

I. delicata Selys.—The dimorphic female, which is a well-developed male-mimicking form, is exceedingly rare, only occurring in a few localities in South-Western Australia. I took it first at Bridgetown on the Blackwood River. The species is by no means common here; out of a dozen females taken two were dimorphs. At Wilgarrup, some fifteen miles from Bridgetown, and in the Warren River district, this species was in great abundance, the males flying up in clouds from the rich grass that fringes the continually running and often boggy creeks. Here I was able to capture a great many females, with the result that about 10% were dimorphs. Three of these had the tips of the abdomen smeared with brown mud, indicating that they had already been ovipositing along the margins of the creek.

The following is a comparative description of the two forms:—

Ischnura delicata Selys ♀.

Total length 24-25 mm.; abdomen 19-20 mm.; forewing 14-15 mm.; hindwing 13-14 mm.

W i n g s: Neuration very slender, pterostigma lozenge-shaped, 0·6 mm., very pale dirty brown. *Nodal Indicator* $\left|\begin{array}{cc}2 & 6\text{-}8\\ 2 & 5\text{-}6\end{array}\right|$ H e a d: *Eyes* black above, yellowish-green in front and below; a brilliant pale blue spot on the orbit behind each eye. *Epicranium* black, with a transverse yellowish-green band in front next the clypeus, in a line with the green portion of the eyes. *Clypeus* black; *labrum* yellowish; *labium* pale dirty greyish-white, or straw-coloured. T h o r a x: *Prothorax* black above, yellowish on sides. *Meso-* and *metathorax* black above, with a pair of narrow olive-green or yellowish-green bands, sides greenish. *Legs* pale yellow or straw-coloured, femora marked with a black line for half their length from elbow.

FORM A.	FORM B.
Abdomen cylindrical, stouter than in male. Colour: 1-7 metallic black above (sometimes dull black or greenish-black), a pale transverse line in each suture; 8-10 dull black. Sides of all segments greenish.	Abdomen shaped as in A. Colour: 1 black above; sutures between 1 and 2 red; 2 with an irregular black basal patch; 3-5 bright red, a fine black transverse band along all the sutures; 6, four-fifths bright red, anal one-fifth black; 7 deep metallic black, basal and anal sutures touched with red; 8, basal two-thirds black, anal third pale blue; 9 blue, touched with black at base; 10 short, black. Sides of all segments pale orange.
Appendages separate, 0·15mm., subconical, rather blunt, black.	*Appendages* shaped as in A, brownish.

In a variety of Form B, taken at Wilgarrup, segment 2 of abdomen has basal half red with a large cup-shaped black mark, anal half black; 3-4 have a transverse anal black band, and 3 a transverse central black line; also the black line along the sutures of 3-5 is enlarged into a conspicuous narrow band. A similar variety occurs in the male, also intermediate forms.

Genus AGRIOCNEMIS.

A. pruinescens Tillyard.—The male of this insect is a dull blackish insect with the first two and last but one segments of abdomen clouded with greyish bloom. While in North Queensland I failed to capture the female, but a few months later I received from Mr. E. Allen, of Cairns, one male and three females of this species. The females are most remarkable, bearing not the slightest resemblance to the male; a first examination of them made me think they were orange forms of some species of *Ischnura*, as they bear a remarkable resemblance to that genus. However, the position of the first antenodal arising before the

arculus fixes them in the genus *Agriocnemis*, and their size and general facies show that they cannot possibly be the females of any but this, the largest of the genus. As the only specimens of this insect known are the three males and three females in my own collection, it is quite possible that an ordinary form of the female may be found to exist when further captures are made.

The following is a description of the female:—

Form A.—(Not known).

Form B.—Size variable. Total length 29-34 mm.; abdomen 22-26 mm.; forewing 18-20 mm.; hindwing 17-19 mm.

W i n g s: *Pterostigma* lozenge-shaped, 0·8 mm., very pale brownish, darkest at inferior angle. *Nodal Indicator* 2 8 / 2 7. H e a d: *Epicranium* velvety black, a broad transverse yellow band in front reaching to the eyes and enlarged so as to enclose the postclypeus; *ocelli* pale, front one transparent. *Postclypeus* jet-black, *anteclypeus* yellow; *labrum* dull yellowish; *labium* dirty straw-colour. T h o r a x: *Prothorax* black above, yellowish on sides. *Meso-* and *metathorax* rich orange, with a broad black dorsal ray, narrowing somewhat anally. *Legs*, coxæ, and femora orange, rest dull blackish. A b d o m e n cylindrical, 1-2 and 8-9 slightly enlarged. Colour: 1 pale orange; 2 orange with a large black dorsal mark shaped like a bishop's mitre, or sometimes like an inverted goblet; 3-7 metallic bronzy-black, a pale transverse yellowish line in the sutures; 8-9 black, with a pale yellowish spot on each side; 10 black. Sides and underside of abdomen yellowish. A p p e n d a g e s very short, separate, conical, black.

[For description of male, see these Proceedings for 1906 (p.177) "New Australian Species of the Family Agrionidæ."]

A. splendida Martin.—This is the commonest of the Australian species of this genus, having been taken by myself at Atherton in North Queensland, and also by Captain Billinghurst on the Goulburn River at Alexandra (Vic.). M. René Martin has described the species, but owing to the colouration of the living

insect fading when dead, his description varies considerably from that of the living insect itself. Last December I took a long series of this insect at Alexandra (Vic.), and the description I made from them corresponds almost exactly with that of the North Queensland specimens which I took two years ago, although the Victorian insects are slightly larger. This species exhibits strong dimorphism, having both an ordinary type of female (similar to the male) and also a fairly abundant red form, nearly as common as the other.

The colour of the male is a rich bronze-green, *not* a brilliant green as stated by M. Martin. The dimorphic female is a deep brick-red, *not* yellow or orange. The following is a comparative description of the two females :—

A. splendida Martin ♀.

Total length 20-23mm.; abdomen 17-19mm.; forewing 11-14mm.; hindwing 10-13 mm.

Wings: Pterostigma rhomboidal, 0·5 mm., dull olive-brown.
Nodal Indicator $\left\|\begin{matrix} 2 & 7 \\ 2 & 6\text{-}7 \end{matrix}\right|$

FORM A.

Head.—*Eyes* black above, greenish beneath, orbits black underneath. *Epicranium* brilliant bronze, giving copper-red reflections; *behind each eye is a large spot of deep metallic blue. Postclypeus pale blue* shading to greenish in centre; the blue colouration enlarged on to the eyes; *anteclypeus metallic bronzy-green*, clypeal suture black. *Labrum pale blue*; *labium* dull dirty yellowish-white, mouth tipped with black.

FORM B (dimorph).

Head.—*Eyes* black. *Epicranium* deep bronze, *lacking the metallic blue postocular spots*; a broad transverse yellowish band in front extending to the eyes and surrounding the clypeus. *Postclypeus black*; *anteclypeu s*and *labrum yellowish*; *labium* pale dirty yellowish-white.

Form A.	Form B.(dimorph).
Thorax.—*Prothorax bronze. Meso-* and *metathorax* deep bronze-green with an irregular *light blue* patch low down on each side, extending from hind wing-join to between meso- and metacoxæ; the blue edged with black. *Scuta* and *scutella* blue.	Thorax.—*Prothorax rich brick-red. Meso-* and *metathorax* deep metallic bronzy-black above; sides and notum *rich brick-red.*
Legs very long; deep brown or black.	*Legs* very long, femora rich brick-red, or red-brown, rest dull blackish.
Abdomen cylindrical; 1-8 *rich bronze* touched with yellow lines in the sutures; 8 with a transverse *blue* anal mark; 9 *blue* with a double basal bronze spot (separated into two separate spots in some specimens); 10 *blue* with a small double central spot of bronzy-black. Underside dull blackish.	Abdomen cylindrical; 1 *rich brick-red*; 2 *red*, with a narrow transverse basal black band and a black anal spot; 3-9 dark bronze, sutures pale; sides of 8-9 dull orange-red; 10 black above, orange-red on sides.
Appendages short, separate, rather blunt, dull brownish.	*Appendages* as in A, dull yellowish-brown.

A. argentea Tillyard.—Only one form of female is known. The colour of the male is silvery-white, due to a bloom forming all over the insect. Where this is rubbed off, the groundcolour is seen to be black. The colour of the female is black. I consider this as the ordinary form of female; the "red" or dimorphic form being either not known or obsolete.

A. velaris Selys.—This rather rare insect occurs in North Queensland at Atherton, and also sparingly about Sydney. In both localities I have taken only one form of female, which differs completely from the male, being a "red" or dimorphic

markings of the thorax show great similarity with "orange" female of *A. pruinescens* described above, ndcolour is dull red and the insect is very much here may be also an ordinary form of female, yet to it may be, obsolete. I have only half-a-dozen females t altogether.

ving table exhibits the classification proposed for the s of the two genera.

Genus Ischnura.

Male.	Females. Form A (ordinary)	Females. Form B (dimorph)	Proportion of Form B to total number of Females.
bronze and blue	dull black	imitates ♂	30-40 %.
red and blue	dull black or olive-green	imitates ♂	10 % in S. W. Australia ; absent elsewhere.

Genus Agriocnemis.

Male.	Females. Form A (ordinary)	Females. Form B (dimorph)	Proportion of Form B to total number of Females.
black with grey bloom	(wanting)	orange	100 %.
bronze and blue	similar to ♂	red	40 %.
silvery-white (groundcolour black)	black	(wanting)	0 %.
bronze with red tip	(wanting)	red	100 %.

sion I would remark that the two genera in which is shown to occur, though differing widely in their re, have many points of similarity, notably the small k flight of almost all the species, the general facies

of the insects, particularly the build of the head and thorax, and the relative proportion of expanse of wing to total length (about 5 to 4 in both genera). So great is this similarity that, if the wings were removed from one of the "orange" females of *Agriocnemis pruinescens*, one would unhesitatingly declare it to be a new form of the female of *I. heterosticta* or an allied species; and such I took it to be until I saw the difference in the neuration of the wings. That the same cause has brought about dimorphism in both genera is scarcely open to doubt; and it is probable that the dimorphism is in some way connected with the preservation of the species.

WEDNESDAY, JUNE 26TH, 1907.

linary Monthly Meeting of the Society was held in
n Hall, Ithaca Road, Elizabeth Bay, on Wednesday
une 26th, 1907.

H. Lucas, M.A., B.Sc., President, in the Chair.

sident called attention to a presentation copy of the
of Carl von Linné, by Professor Th. M. Fries (2 vols.),
varded by Count Mörner, Consul for Sweden in Sydney,
hor's behalf; and he stated that the Consul had been
onvey to the distinguished author the Society's very
nks for this exceedingly opportune and highly appreci-
because many portraits, and representations of historic
objects to be found in these volumes had hitherto been
h.

sident also called attention to another most interesting
namely, a presentation copy of the "Record of the
of the Two Hundredth Anniversary of the Birth of
Franklin, under the auspices of the American Philo-
Society held at Philadelphia for promoting Useful
e, April 17th-20th, 1906 (1906)" from the American
cal Society. An appropriate acknowledgment would
t the earliest opportunity.

request of Professor Liversidge the attention of
was called to circulars of information respecting the
stablished "British Science Guild" whose objects are:

together, as members of the Guild, all those throughout the
re interested in Science and Scientific Methods, in order by joint
to convince the people, by means of publications and meetings,
necessity of applying the methods of science to all branches of
n endeavour, and thus to further the progress and increase the
re of the Empire.

2. To bring before the Government the scientific aspects of all matters affecting the national welfare.
3. To promote and extend the application of scientific principles to industrial and general purposes.
4. To promote scientific education by encouraging the support of Universities and other Institutions where the bounds of science are extended, or where new applications of science are devised.

An Association with aims of this character was certain worthy of support; and Members who desired to come into touch with it, were recommended, in the first place to apply for the literature, which was available on application.

Attention was also directed to a circular from the promoters of the proposed "Souscription Universelle pour élever un Monument à Lamarck." The President commended the matter to the notice of the Society; and he stated that Dr. H. G. Chapman, of the University, would be glad to receive contributions, and forward the same to Paris.

A letter of thanks from Mrs. Alexander Morton, of Hobart, for kind sympathy was communicated to the Meeting.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 14 Vols., 83 Parts or Nos., 14 Bulletins, 1 Report, and 28 Pamphlets, received from 54 Societies, &c., and 3 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. David G. Stead recorded that during the month an exceedingly large shoal of great Tunnies had made its appearance on the coast of New South Wales, having been reported from the entrances of both Port Hacking and—a few days later—Port Jackson. Individuals of the shoal averaged about six feet in length. One large example, forwarded to the Department of Fisheries, had been examined by Mr. Stead, who stated that the species was an addition to the New South Wales fish-fauna, and that he had identified it provisionally as *Germo maccoyi* (Castelnau).

It had been placed in Jordan's genus *Germo* because of the large pectoral fins, but the validity of that genus was open to doubt. The species was closely allied to Temminck and Schlegel's *Thynnus macropterus*.

Mr. T. G. Taylor exhibited photographs which filled a gap between ordinary camera photos ($\frac{1}{1}$) and microphotos ($\frac{10}{1}$), obtained by the use of an Express Enlarger, giving magnifications direct from the micro-section of 2 up to 10 diameters. This apparatus is ordinarily used for bromide enlargements or lantern slides, but is very suitable for enlarging large coral calices, which are not wholly visible in the microscope field. Imperial Special Rapid Plates were used; blue sky, 2-10 seconds exposure.

Mr. Froggatt exhibited a sample of the seed of some forage plants, recently imported from France, which had mixed with it numbers of dried land snails (*Helicella candidula* Studen).

Dr. Woolnough showed a number of photographs taken in Fiji, in illustration of his paper. A series of lantern slides will be shown at a future Meeting when the lantern is again available.

NEW AUSTRALIAN SPECIES OF THE FAMILY *CALOPTERYGIDÆ.*

BY R. J. TILLYARD, M.A., F.E.S.

Only one species of this exceedingly beautiful and interesting family has so far been described from Australia, viz., *Diphlebia lestoïdes* Selys. Two additions are now made, one being a common East Indian species, and the other a beautiful Diphlebia from Northern Queensland.

It is probable that systematic collecting in the Cape York and Port Darwin districts would add several more species of this family to our Australian Odonata, since the *Calopterygidæ* are exceedingly well represented in the tropical zone.

1. DIPHLEBIA EUPHŒOIDES, n.sp.

♂. Total length 48-52 mm., abdomen 35-38 mm.; wings, fore 29-31 mm., hind 28-30 mm. Wings rather broad; suffused almost completely with dark brown or black (in the young ♂ with pale yellowish-brown); the only portions not suffused being the tip beyond the pterostigma and also the basal part of the wing including the costal, subcostal, and median spaces. *Pterostigma* 4 mm. black. *Nodal Indicator* ‖5-8 circ. 24 | 5-6 circ. 20‖ Head: All parts jet black; vertex and genæ hairy; a slight dark brown patch close under the eyes next the vertex; middle of labium dirty grey. Front ocellus transparent; antennæ black, nearly 3 mm. Thorax: *Prothorax* jet black with four bright blue spots, two narrow transverse elongated, one of which is basal and the other anal, and two lateral, oval, pointed inwards. *Meso-* and *metathorax* soft rich sky blue, dorsal ridge black, widening into a black triangular patch next the prothorax and

ınd to join the subhumeral black rays of which there
ach side, reaching to the fore wing-joins, and below it
ateral black ray reaching to the hind wing-join; all the
rked by thin black lines. Wing-joins black, spotted
scuta and scutella blue. Underside dirty grey or
ged with black. *Legs* black, powdered with grey.
n cylindrical, 1-3 slightly swollen. Colour : 1, blue,
suture; 2, blue, suture broadly black, a black semi-
oot two-thirds of the way from the base and connected
hin black line along the dorsal ridge; sides of 2 black;
o-thirds blue, rest black, a thin black line along the
e, sides and underpart black; 4-7, jet black; 8, blue;
ween broadly black sutures, the black on the basal
rply pointed inwards along the dorsal ridge; 10, black
ir of oval blue spots; 9, swollen below into a small
bercle. Underside black, powdered with grey around
l appendages of segment 2, which are large and black.
l a g e s : *Superior* forcipate, nearly 2 mm., jet black,
slightly clubbed and downy, nearly touching; seen
he tips are slightly curved downwards. *Inferior* (two)
n., subcylindrical, black, tips blunt, in some specimens
in others close together and parallel.

l length 44-46 mm.; abdomen 31-33 mm.; wings, fore
, hind 31-33 mm. W i n g s longer and narrower than
rally almost completely suffused with dull brown or
orown; sometimes, especially in immature specimens,
Pterostigma 4 mm., brown or dark brown. There are
ct types of the ♀ which I shall designate *A* and *B*. In
ınd colour of the thorax and abdomen is either dull
n, slightly metallic, or else dull smoky black. In *B* it
ellowish-brown. H e a d : *Vertex*, *A*, dark olive brown,
own; a curved black band between the antennæ touch-
ont ocellus; behind this an irregular black band or series
eaching from eye to eye and enclosing the two other
Behind this the occiput is swollen, almost tubercled;
t the eyes black; a black or dark brown line across the

occipital ridge. *Eyes* black, bordered in front by a bright creamy or yellowish band. *Clypeus* and *labium* brownish, darker in *A* than *B*; *labium* pale dirty brownish, mouth deeply edged with black. Thorax as in ♂, but with the blue parts replaced by the ground colour of *A* or *B*. Underside dusted with grey. *Legs* black, dusted with grey on underside of femora. Abdomen cylindrical; 8 slightly narrowed basally; 10 very small. Colour as mentioned above and marked as follows :— dorsal ridge black, swelling out in 4-8 into an anal black spot; 3, with a wide black spot three-fourths of the way from the base; 2, with a suspicion of the same. Sides edged with dull black. These markings are very conspicuous in *B*, but indistinct in *A*. Segments 8-10, very much swollen below, ovipositor large, ending in a pale blunt tip pointed slightly upwards and carrying below the tip two curved filaments, black, divergent and inclined downwards, about 0·6 mm. long. *B* has a brown colouration on sides of 9 and 10. *Underside*, *A* black, dusted with grey; *B* shining black. Appendages black, 1 mm., subcornute, separated.

Hab.—Kuranda, N.Q., Nov.-Feb., where it is fairly abundant on the small and densely wooded mountain creeks, but it is not found along the main river. I have also received specimens from the Cape York district.

It has a graceful easy flight, often fluttering like a butterfly round twigs and leaves. It is extremely fond of settling on logs or twigs near the water with expanded wings. The females are very retiring, and are generally found a short distance in the bush away from the creek where the males are disporting themselves. One form of the female is about as common as the other, and it is possible that the difference is only one of age, the form *A* being the fully matured female; though, as I found both forms common late in the season, I cannot say for certain that this is the case.

There is no doubt as to the specific distinctness of this beautiful insect, though perhaps it will be as well to give the points of difference between it and *D. lestoïdes* Selys, the only other known species of the genus, which is common in Victoria and Southern

New South Wales. The following characteristics will at once distinguish the two species:—

♂. The ♂ of *D. lestoïdes* is a larger insect that *D. euphæoïdes*, but its wings are decidedly narrower. Moreover, the wings of *D. lestoïdes* ♂ are never clouded even with the palest brown, while those of *D. euphæoïdes* ♂ even in very immature specimens are distinctly clouded. In *D. lestoïdes* ♂, about half-way between the nodus and pterostigma, there is a milk-white bar of thickness varying from 1·5 to 3 mm. running across the wing; this is absent in *D. euphæoïdes*. In *D. lestoïdes* ♂ the ground colour of the whole abdomen is blue; in *D. euphæoïdes* ♂ only the first three segments and 8-9 are blue, the rest being black. As regards the appendages, the superior ones in *D. lestoïdes* are distinctly larger than those of *D. euphæoïdes*; while the inferior are absolutely different; those of *D. euphæoïdes* being subcylindrical and with blunt *rounded* tips, while those of *D. lestoïdes* are scarcely one-fourth as long as the superior, and are wide and distinctly square at the tips, and even somewhat hollowed out so as to appear slightly bifid when viewed laterally. It may also be observed that the abdomen of *D. lestoïdes* ♂ is distinctly flattened, rather wide, and of practically the same width from end to end, while that of *D. euphæoïdes* is much narrower and varies in width, being widest at 1-2, then tapering gracefully to 7, then slightly enlarged again to 10. It is also distinctly rounded and not flattened. The second segment of the abdomen is hairy in *D. lestoïdes* ♂, smooth in *D. euphæoïdes*.

♀. The two females, if placed side by side, would be more difficult to distinguish, as they are very similar in general colouration and appearance. But *D. lestoïdes* ♀ is distinctly larger than *D. euphæoïdes* ♀; its wings are very seldom suffused with brown, and are much narrower than those of the latter, especially towards the tips, which in *D. euphæoïdes* are beautifully rounded. The pterostigma is always very pale brown between black nervures in *D. lestoïdes*; in *D. euphæoïdes B* it is a medium brown, and in *A* a very dark brown. The appendages are very similar.

The specific name is adopted on the suggestion of M. Marti as to maintain the uniformity of the specific nomenclature in for this genus.

Note on *D. lestoïdes* Selys.—In making the foregoing comp son, I have had recourse only to my own series of this in taken during Dec.-Jan., 1905, on the Snowy River, Jindab N.S.W. M. René Martin, in his remarks* on the specimens him from Victoria, says:—"Elle varie tellement pour la tail la coloration qu'on serait tenté de voir deux espèces distin quand on considère un grand mâle *tout vert mat* ou bleu lui ayant un abdomen de 35 à 36 mm. et 7 anténodales, et d'a part un petit mâle plus on moins varié de noir sur le corps, a un abdomen de 30 mm. et seulement 4 anténodales, mai trouve toutes les tailles et toutes les colorations intermediai

The specimens to which these remarks apply were taken the Goulburn River, Victoria, if I mistake not. On the Sn River I took and examined hundreds of specimens, and I truly say I found exceedingly little variation in size, not than 2 mm. either in length of abdomen or expanse of w The newly emerged ♂ has a flabby brownish abdomen ma with black, very similar to that of the ♀, and it takes some w before the rich blue colour has covered the whole body. A some days old shows the blue colouration beginning from 2nd segment downwards, and one can meet with them i stages of colouration. But I am certain that the insect is n *dull green* (*vert mat*). Dried specimens generally lose colour entirely and turn dull black or brown, but several matured specimens I had, turned a deep dull green and rema so for many weeks, though that colour has now disappe Doubtless some of M. Martin's specimens reached him in condition. As regards the variation in size, it must be du the colder climate and the later advent of summer in Vict whereby many specimens never reach full maturity; for eve the Snowy River at the end of January most of the speci were flabby, ill-nourished, and but half-matured.

* Mémoires de la Société Zoologique de France, 1901, pp.243-244

2. *Rhinocypha tincta* Ramb.

male of this species which I now possess, in very bad
as taken in 1869 on the Endeavour River, Cooktown,
ir William Macleay's collectors. The species is an
common one all over Oceania and the Indies, and it
al certainty that it must occur at Cape York and
sland; though the absence of any collections of
m that district accounts for its not being recorded

men I possess is possibly var. *semitincta* from the
uffusion of the wings, but all colouration has been
long ago. It would be useless to attempt to describe
iption of the type is given by Rambur, and Selys also
on the species [Ramb., Ins. Névr. p. 237 (1842);
Calopt. p. 64 (1853); Mon. Calopt. p. 253 (1854);
Belg. (2), xxvii. p. 663 (1869); (2), xxxv. p. 490
xlvii. p. 395 (1879)].

REVISION OF THE AUSTRALIAN CURCULIONIDÆ BELONGING TO THE SUBFAMILY *CRYPTORHYNCHIDES.*

PART VIII.

BY ARTHUR M. LEA.

(Continued from Proceedings, 1905, p.258.)

In this contribution and Parts 5, 6, and 7 of the revision, the genera allied to *Cryptorhynchus* are dealt with. These genera may be regarded as forming several closely allied sections, *Cryptorhynchus* and *Tyrtæosus* with several close allies forming one section; *Perissops* and its many close allies forming another; *Protopalus* with its allies forming a third, and this the most distinct section.* *Aonychus* and *Mecistocerus*, although at a glance widely separated (and actually placed in different groups by M. Lacordaire), are closely allied, on account of a supplementary prosternal process (which appears to denote an approach to *Camptorrhinus*); with them may be doubtfully placed *Berosiris* and *Microberosiris*; *Imalithus*, *Paratituacia* and *Sympediosoma* lead off to and might fairly be claimed as belonging to the *Chætectetorus* group; *Nechyrus* might be regarded as belonging to the *Poropterus* group.

In most of the species the clothing is not very dense; it is often prettily variegated, and can usually be relied upon. Few of the species are tuberculate, but many are granulate. Many of the genera are very distinct and may be readily identified. The rostrum is frequently long and thin, and is never straight. The

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* *Protopalus* and its allies have been regarded as forming a very distinct and isolated section, but there are several genera that clearly lead up to it from *Perissops*.

invariably present, and is often of comparatively The metasternum is usually almost as long as the gment, sometimes it is even longer; its episterna are listinct. The abdominal sutures are always distinct; first and second is frequently curved in the middle, segments are never closely soldered together; the are often drawn slightly backwards at the sides, ond is sometimes not at all or but slightly longer rd or fourth. In *Aonychus* the claw-joint is absent, ew of the other genera are the tarsi at all remarkable. ed.

ving table is arranged solely for convenience of .

iculate.. AONYCHUS.
lriarticulate.
ly depressed .... IMALITHUS.
re or less strongly convex.
barbed in the male........................ GLOCHINORRHINUS.
barbed in neither sex.
um with supplementary processes.... MECISTOCERUS.
rnum without supplementary pro-
s.
femora bidentate........................ SYBULUS.
ior femora only bidentate.............. CRITOMERUS.
ora unidentate or edentate.
coxæ exposed internally.
r lobes distinct............................ BEROSIRIS.
ar lobes absent.......................... MICROBEROSIRIS.
lle coxæ not exposed internally.
sternal receptacle open.
e shorter than funicle.
ire between first and second abdo-
inal segments distinct.................. NEOMYSTOCIS.
is suture more or less obliterated in
iddle.. NECHYRUS.
pe the length of or longer than
nicle.
ytra at base not much wider than
othorax.................................... ENTELES.

dd. Elytra at base much wider than prothorax.
e. Elytra bisinuate at base.................. PROTOPALUS (in part).
ee. Elytra trisinuate at base.................. EPISODIOCIS.
GG. Mesosternal receptacle cavernous.
H. Metasternum longer than the following segment.
f. Three intermediate segments of abdomen almost equal..................... BLEPTOCIS.
ff. Abdomen with second segment much longer than third or fourth......... NOTOCRYPTORHYNCHUS.
HH. Metasternum shorter than the following segment.
I. Eyes coarsely faceted.
g. Posterior femora passing elytra.
h. Prothorax longer than wide......... PEZICHUS.
hh. Prothorax transverse............... BOTHYNACRUM.
gg. Posterior femora not passing elytra.
i. Second abdominal segment very little, if at all longer than third or fourth.
j. Femora dentate..................... CRYPTORHYNCHUS.
jj. Femora edentate................... ANIPIGRAPHOCIS.
ii. Second abdominal segment much longer than third or fourth.
k. Femora edentate.
l. Elytra scarcely wider than prothorax.......................... QUEENSLANDICA.
ll. Elytra much wider than prothorax at base.................. SCLEROPOIDES.
kk. Femora dentate.
m. Suture between two basal segments of abdomen straight....................... TYRTAEOSUS.
mm. This suture curved in middle.
n. Elytra bisinuate at base.... PSEUDOTEPPERIA.
nn. Elytra trisinuate at base.
o. Scape the length of funicle HYPERIOSOMA.
oo. Scape shorter than funicle SYMPEDIOSOMA.
II. Eyes finely faceted.
J. Suture between two basal segments of abdomen straight......................... PROTOPALUS (in part).

J. This suture curved in middle.
K. Posterior femora passing elytra........ DYSOPIRHINUS.
KK. Not passing elytra.
L. Femora edentate... .... PARATITUACIA.
LL. Femora dentate.
M. Scape considerably longer than funicle................................. BLEPIARDA.
MM. Scape the length of or shorter than funicle.
N. Each elytron separately rounded at base.
p. Shoulders projecting..... ORPHANISTES.
pp. Shoulders not projecting TEPPERIA.
NN. Elytra trisinuate at base.
O. Tibiæ angular externally........... METRANIOMORPHA.
OO. Tibiæ (except sometimes the middle) not angular externally.
P. Tibiæ almost straight............ AXIONICUS.
PP. Tibiæ more or less distinctly curved.......................... PERISSOPS.

Genus MECISTOCERUS Fauvel.

oc. Linn. de Normandie, vii. p.159.

mall, convex, not concealed; ocular fovea distinct and rge. *Eyes* large, triangularly ovate, widely separated l almost contiguous below, coarsely faceted. *Rostrum* thin, curved. *Antennæ* thin or moderately thin; inser- cape variable; basal joints of funicle variable; club l and long or moderately long, sutures oblique. *Pro-* ansverse, sides rounded, apex moderately or strongly and produced, base bisinuate, constriction slight, ocular se. *Scutellum* distinct. *Elytra* slightly or considerably n prothorax, widest across shoulders. *Pectoral canal* narrow, terminated at base of or just behind inter- oxæ, with walls between four anterior coxæ that are rtly by the pro- and partly by the mesosternum. *Meso-* ceptacle narrow and transverse, scarcely distinguishable metasternum and leaving the coxæ exposed; open. *um* shorter or slightly longer than the following seg-

ment; episterna wide. *Abdomen* with the 1st segment as long as 2nd-3rd combined, intercoxal process not very wide and semicircular, apex incurved or straight; 3rd and 4th combined the length of 2nd and distinctly longer than 5th, their sides drawn slightly backwards. *Legs* moderately long; femora dentate, not (or scarcely visibly) grooved, posterior passing elytra or not; tibiæ compressed, more or less distinctly curved or bisinuate, sometimes straight, with a subapical tooth in addition to terminal hook; tarsi not very long, 3rd joint wide and deeply bilobed. Elliptic or subelliptic, convex, squamose, nontuberculate, winged.

A highly remarkable genus. Between the four anterior coxæ the pectoral canal is seen to be bordered by distinct walls; these are principally formed by the prosternum, but also partly by the mesosternum. It is the only genus, other than *Camptorrhinus* and *Aonychus*, in which the prosternum has a supplementary process. The walls are polished internally and appear almost to belong to the mesosternum, but on removing the prothorax it can be seen that there is a narrow basal ridge (traceable across summit but concealed there with elytra in position) that immediately behind the coxæ becomes elevated and forms the wall on each side of the canal. The mesosternal receptacle is not entire, but consists of a short basal piece (seldom distinctly separated from the metasternum) and a short process (concealed entirely unless the prothorax be removed) on each side that fit into the sides of the prosternal walls. The rostrum is frequently very long and is never stout. The sutures of the joints of the funicle are often indistinct. The sexual differences are very pronounced; the male has a shorter and stouter rostrum which is ridged and squamose behind antennæ, and these are inserted closer to the apex than in the female. The genus is not confined to Australia, several species having been described from New Guinea, New Caledonia, &c.

The species of the genus as now defined are not very homogenous in appearance, but it was not considered advisable to generically separate any of them, as the characters of the pro- and mesosternum are the same in all. It is true that they are the

ychus, but the tarsi of that genus are triarticulate. *hinus* the canal is confined to the prosternum. The nt species are *mærens*, *vulneratus*, *egens* and *languidus*, of these it may eventually be considered necessary nus. Both *mærens* and *vulneratus* have a compara- rostrum with rather stout antennæ, and the meta- ger than the following segment; *egens* has also a ly short rostrum with stoutish antennæ, but the is shorter than the following segment; *languidus* in approaches *Pezichus*; it has the femora linear and ntate, the claw-joint very long and thin, and the longer than the following segment; its clothing is r.

ch wider than prothorax; suture between
d abdominal segments straight.
n longer than the following segment.
in and minutely dentate.................... *languidus*, n.sp.
outer and rather strongly dentate.
fovea very large................................ *vulneratus*, n.sp.
fovea rather small...... .... *mærens*, n.sp.
n shorter than the following segment.
lerately curved........ .... *compositus*, n.sp.
ight... .. .. *egens*, n.sp.
ly wider than prothorax; suture between
d abdominal segments curved.
episterna with small punctures in two
.... *tenuirostris*, n.sp.
episterna with large punctures in one

face densely squamose......... ... . *dispar*, n.sp.
face rather sparsely squamose.............. *mastersi*, Pasc.

OCERUS MASTERSI Pasc.; Mast. Cat. Sp. No.5413.

sh-brown, antennæ and tarsi red. Moderately densely fawn-coloured scales, slightly variable in shade and rothorax than on elytra, the latter with two feeble one commencing on shoulders and meeting suture at the other postmedian; each puncture and the inter-

stices with series of stout scales, but smaller than those of prothorax. Under surface very sparsely squamose; legs densely squamose, the femora each with an obscure (often not traceable) whitish ring. Head and basal half of rostrum rather densely squamose.

Head with dense concealed punctures; ocular fovea rather large and deep. Rostrum much longer than prothorax, thin and moderately curved; basal half with moderately strong but concealed punctures and with three narrow ridges, apical half shining and lightly punctate. Scape inserted two-fifths from apex of rostrum and slightly longer than funicle; of the latter the 1st joint is considerably shorter than 2nd but the length of 3rd, the others gradually decreasing in length but none transverse; club cylindrical, not much shorter than four preceding joints. *Prothorax* with dense, round, deep punctures partially exposed on sides but elsewhere concealed; median carina feeble and concealed by clothing. *Elytra* cordate, considerably wider than and about twice the length of prothorax; with series of large deep punctures, becoming smaller posteriorly; interstices lightly convex, wider or narrower than punctures. *Under surface* with distinct but sparse punctures. Metasternum shorter than the following segment, its episterna each with a single row of large punctures. Abdominal sutures straight. *Femora* feebly dentate, the posterior just passing elytra and not very feebly dentate. Length 12½, rostrum 5; width 6; variation in length 9½-13 mm.

♀. Differs in having the rostrum thinner, more noticeably curved, slightly longer, and shining throughout except at extreme base, where also only the median ridge and strong punctures are present. The scape is inserted almost in the exact middle of rostrum.

Hab.—N. S. W.: "Illawarra" (Pascoe), Illawarra; Q.: Wide Bay (Sydney Museum), Rockhampton (Mr. George Masters).

The punctures on the basal half of the elytra are large and more or less confluent, but owing to the clothing they appear to be smaller and not very close together. This is also the case with some of the other species.

MECISTOCERUS DISPAR, n.sp.

kish-brown, scape red, rest of antennæ and tarsi darker. nsely clothed with dark fawn-coloured scales, mixed and blotches of paler and blackish scales, the dark ning four feeble lines down prothorax and a rather nt interrupted triangle on each side of middle of elytra; c scales very little larger than those on elytra, punctures taining larger scales. Under surface densely squamose, rd and 4th abdominal segments dark except at sides; d tibiæ each with an obscure blackish ring. Basal strum squamose.

th dense concealed punctures; ocular fovea of moderate iangular and deep. Rostrum slightly longer than pro- l scutellum combined, thin and moderately curved; basal vith moderately strong punctures and with three narrow ewhere shining and lightly punctate. Scape inserted earer base than apex of rostrum and shorter than t joint of the latter the length of 3rd and noticeably an 2nd, the others regularly decreasing in length, 7th ; club cylindrical and moderately long. *Prothorax* , round, deep, non-confluent, partially concealed punc- lian carina narrow, shining and not quite continuous d apex. *Elytra* cordate, considerably wider than and e the length of prothorax; with series of large punc- ming smaller posteriorly and all partially concealed; gently convex, on basal half narrower, on apical half n punctures, but apparently wider throughout. *Meta-* ightly shorter than the following segment; with large dense punctures, which on each of the episterna are o a single row. Abdomen densely punctate, suture st and 2nd segments slightly curved; 1st with almost unctures as on metasternum. *Femora* stout, acutely posterior extending to apex of elytra. Length 9, }; width 4 mm.

rs in being of considerably larger size, proportionately ss shoulders and more suddenly narrowed posteriorly

than in the ♂; the rostrum is longer, shining except at extreme base, and the scape inserted at basal two-fifths. Length $12\frac{3}{4}$, rostrum $4\frac{1}{2}$; width 6 mm.

Hab.—Q.: Endeavour River (Macleay Museum), Cooktown (Mr. C. French).

Each of the large scales of the under surface instead of being placed in the middle of a puncture is placed at its base, so that although the depth of the puncture is concealed its extent is readily seen.

MECISTOCERUS TENUIROSTRIS, n.sp.

♂(?). Blackish-brown, antennæ and claw-joints paler. Not very densely clothed with rather pale ochreous-brown scales, which are longer on prothorax than on the elytra; on the latter they are moderately dense on the interstices, on the former they are confined to the punctures; with small spots and blotches of pale scales scattered about. Under surface rather sparsely clothed, the clothing, except on sides of sterna, more or less setose in character; femora feebly ringed. Basal third of rostrum squamose.

Head in places coarsely and densely punctate, the punctures more or less concealed; ocular fovea deep, narrow and elongate, being fully half the length of head. Rostrum long, thin and moderately curved, considerably longer than prothorax; basal two-fifths rather coarsely punctate and with three narrow ridges, the median one of these being traceable to between the antennæ where it terminates in a very feeble elongate impression; elsewhere shining and lightly punctate. Scape inserted very slightly closer to apex than base of rostrum and slightly shorter than funicle; of the latter the 2nd joint is thin, twice the length of the 1st, and the length of the 3rd and 4th combined, the others gradually decreasing in length but none transverse; club the length of the four preceding joints. *Prothorax* with dense round and rather shallow punctures, each of which contains but is scarcely obscured by a scale; median carina entirely absent. *Elytra* cordate, considerably wider than and more than twice the

prothorax; with series of moderately large elliptic interstices not separately convex, wider than punc-ughout, themselves punctate. *Metasternum* shorter following segment, triangularly encroached upon by large punctures except on episterna, each of which is ith two rows of small punctures. Abdomen with tures, 1st and 5th with dense, the 1st with large 2nd-4th very sparsely punctate. *Femora* rather thin y dentate, posterior extending to apex of elytra. rostrum 3½; width 4½ mm.

ueensland (Herr J. Faust).

scales form five feeble spots on the prothorax, clothe ler and form rather irregular spots about the middle ra; on the head they form a very distinct large round

MECISTOCERUS COMPOSITUS, n.sp.

ish-brown, antennæ and tarsi paler. Densely clothed cept on scutellum and apical two-thirds of rostrum) coloured scales, with spots and blotches of dark scales bout or entirely absent.

ith dense concealed punctures; ocular fovea subtri-d not very large but deep. Rostrum the length of and scutellum combined and (for the genus) compara-t; basal half rather coarsely punctate and with three ges, apical half shining and lightly punctate. Scape o-fifths from apex of rostrum and slightly shorter than the latter the first joint is slightly longer than the 3rd erceptibly shorter than the 2nd, 6th and 7th feebly club elongate-elliptic. *Prothorax* with large, round, onfluent, scarcely concealed punctures; median carina ly in middle. *Elytra* elongate-cordate, not much wider orax and almost thrice as long; with series of large ctures becoming smaller posteriorly; interstices (except) narrower than punctures, although apparently every-ler; basal half with small granules, but which are ncealed. *Metasternum* shorter than the following seg-

ment, with large partially concealed punctures even on episterna, each of which, however, is supplied with but one row. Abdomen densely punctate and with straight sutures. *Femora* stout, acutely dentate, posterior almost extending to apex of elytra, their teeth large, tibiæ distinctly curved. Length 7¼, rostrum 2¼; width 3⅓ mm.

♀. Differs in being considerably larger and rather wider, the rostrum much longer and shining except at extreme base; the scape is inserted nearer the base than the apex of rostrum. Length 9½, rostrum 3½; width 4½ mm.

Hab.—Australia (Herr J. Faust); Q.: Salisbury Plain (Mr. A. Simson), Cape York (Macleay Museum).

The dark patches of scales are very variable in extent, especially on the males; they usually form a distinct but irregular postmedian fascia, but this is sometimes completely absent; usually there is a smaller and less distinct fascia beyond it, the intervening space being clothed with slightly paler scales than elsewhere; usually there is a very feeble dark stripe on each side of the median carina (which is marked by paler scales); the femora are seldom distinctly ringed.

Mecistocerus mærens, n.sp.

♂. Black, antennæ not much paler. Moderately densely clothed with obscure sooty-brown scales indistinctly variegated with small spots of pale scales. Head and basal half of rostrum densely squamose.

Head with dense concealed punctures; ocular fovea deep and distinct but smaller than usual. Rostrum the length of prothorax and scutellum combined, lightly curved, sides feebly incurved to middle; basal half with coarse partially concealed punctures and with three ridges, the median one of which is traceable to apical fifth, apical half opaque and with rather dense and coarse but not concealed punctures. Scape inserted two-fifths from apex of rostrum and slightly shorter than funicle; joints of the latter rather stout, the 1st slightly longer than the 2nd, 3rd-7th subglobular, 7th feebly transverse; club elliptic-

rothorax scarcely longer than wide; with dense, round,
rly-cut, non-confluent large punctures; median carina
ıd waved by punctures. *Elytra* elongate-cordate, not
ler than prothorax and almost thrice as long; with
arge suboblong punctures, each of which is separated
e ridge, both ridges and punctures partially concealed;
gently convex and wider than punctures throughout.
face densely and moderately strongly punctate through-
asternum longer than the following segment. Abdo-
ıres straight. *Femora* moderately stout but sublinear,
ıtely dentate, posterior not extending to apex of abdo-
ngth 12, rostrum 3½; width 5; variation in length

rs in having the rostrum slightly longer, straighter and
(except at base), shining and (except at basal fourth)
tures of only moderate size and the ridges absent; the
inserted just perceptibly nearer apex than base of

Australia(Herr J. Faust); N.S.W.: Orange(Mr. Horace
ı), Forest Reefs (Lea); Tasmania (Mr. A. Simson).
thing of the prothorax is rather sparse, except at the
usually forms three feeble pale lines; usually on the
(otherwise very indistinct) preapical callus is supplied
nall spot of pale (almost white) scales; the patches of
elsewhere seldom cover more than one puncture. On
mens, however, the pale scales clothe the greater part
m, the sooty ones being distributed in small spots and

time I thought this species was possibly Boheman's
ynchus mæstus, but that species is described as having
rior femora obtusely dentate (and by implication the
entate) and the scutellum clothed. In the (eleven)
under observation the scutellum is perfectly glabrous.

MECISTOCERUS VULNERATUS, n.sp.

ckish-brown, elytra paler, antennæ of a rather bright
derately densely clothed with rather large pale (often

white) scales, having a more or less speckled appearance. Legs densely, under surface moderately densely squamose. Head and basal half of rostrum squamose.

Head with coarse partially concealed punctures; ocular fovea deep, subtriangular and unusually large, its walls shining. Rostrum very little longer than prothorax, sides lightly incurved to middle; basal half with coarse, partially concealed punctures and with three acute ridges; apical half subopaque and with moderately large but not dense punctures. Scape inserted at about the middle of rostrum and much shorter than funicle; of the latter the 2nd joint is distinctly longer than the 1st, and the 7th is transverse; club cylindrical. *Prothorax* strongly convex and distinctly transverse, sides strongly rounded; with moderately large, dense, round, clearly cut, non-confluent punctures; median carina very feeble and rather short. *Elytra* not much wider than prothorax and more than thrice as long; with series of moderately large, oblong, more or less confluent punctures, becoming not much smaller posteriorly; interstices not separately convex, much wider than punctures, themselves rather densely punctate. *Under surface* densely and moderately strongly punctate throughout. Metasternum longer than the following segment. Abdominal sutures straight. *Femora* rather short and not very acutely dentate, posterior scarcely extending to apical segment. Length 8, rostrum 2; width $3\frac{1}{2}$ mm.

♀. Differs in having the rostrum rather wider than in the male, highly polished and lightly punctate except at basal third, and the scape is inserted slightly closer to base than apex of rostrum.

Hab.—Q.: Cooktown (Mr. C. French).

A narrow, cylindrical species in which the ocular fovea occupies more than half the space between the eyes; it is the only species here described in which the rostrum of the ♀ is no longer than that of the ♂. The scales are sometimes snowy white and usually form three feeble lines down the prothorax; on the elytra they form more or less irregular narrow fasciæ (on one specimen six of these are traceable), but they are seldom distinct.

MECISTOCERUS LANGUIDUS, n.sp.

ish-brown, antennæ of a rather bright red. Moder-
-ly clothed with fawn-coloured scales of an almost
ıde; on the prothorax they are set in punctures, most
e large and rounded and although depressed are
vated above the derm; they, however, (especially in
etose in character; on the elytra the scales are much
n the large prothoracic ones and each is transverse;
the interstices thickly towards the apex but less so
base; each puncture is supplied with a concave scale.
ace sparsely squamose, the scales varying from short
almost to setæ; legs densely clothed, the anterior
ong thin hair on the apical two-thirds. Head (except
nd basal three-fourths of rostrum rather densely

h coarse concealed punctures; ocular fovea narrow
e. Rostrum long, thin, parallel-sided and moderately
ger than prothorax and scutellum combined; basal
s with rather coarse concealed punctures, and with
lian ridge that terminates between antennæ in a feeble
apical fourth shining and with rather small punctures.
in; scape inserted one-fourth from apex of rostrum
longer than funicle; funicle with the 1st joint the
d and considerably shorter than 2nd, 3rd as long as
h combined, 7th lightly transverse; club cylindrical.
noderately convex, apical third rather strongly and
ounded, basal two-thirds subparallel; with deep
small punctures, regularly but rather sparsely dis-
edian carina absent. *Elytra* oblong-cordate, not much
prothorax and almost thrice as long, base almost
ith series of not very large and feebly transverse
each of which is separated by a feeble ridge; inter-
eparately convex, wider than punctures throughout.
a longer than the following segment, with moderately
ot on episterna where they are small) and not very
tures. Abdomen with rather sparse and irregular

punctures; sutures straight. *Legs* long and thin; femora linear and very minutely dentate, posterior passing elytra; tibiæ straight; 4th tarsal joint thin and almost as long as the rest combined. Length 7½, rostrum 2⅕; width 3⅜ mm.

Hab.—N. S. Wales (Macleay Museum).

The clothing and punctures are remarkable; the transverse scales of the elytra are almost (if not quite) unique in the subfamily. The scape is inserted much closer to the apex of the rostrum than in any other species; the claw-joint is unusually long and thin. Several of the characters are suggestive of *Pezichus*. On the rostrum there may be three obtuse ridges, but only one can be traced on the unique specimen under examination.

MECISTOCERUS EGENS, n.sp.

♀(?). Dark reddish-brown, antennæ of a rather bright red. Not very densely clothed (denser on legs, sparser on under surface and rostrum than elsewhere) with obscure ochreous scales, which are condensed in places into small spots and stripes.

Head with coarse, scarcely concealed punctures; ocular fovea large and open posteriorly. Rostrum slightly longer than prothorax, moderately curved, parallel-sided; basal third with coarse concealed punctures and a distinct median ridge, elsewhere polished and minutely punctate. Scape inserted slightly nearer base than apex of rostrum and shorter than funicle; 1st joint of funicle as long as 2nd and 3rd combined, 3rd-7th gradually increasing in width and all transverse; club ovate, subcontinuous with funicle. *Prothorax* with large, round, deep, scarcely obscured punctures; median carina feeble. *Elytra* cordate, not much wider than prothorax and about twice and one-half as long; with series of large, oblong, subapproximate punctures; interstices not separately convex and narrower (except posteriorly where they are wider) than punctures. *Metasternum* slightly shorter than the following segment, coarsely and irregularly punctate. Abdomen with straight sutures; 1st segment rather coarsely punctate, 2nd with two feeble rows on basal half, 3rd and 4th almost impunctate. *Femora* rather thin, not very acutely dentate, posterior

extending to apex of elytra; tibiæ straight. Length $3\frac{1}{4}$, rostrum 1; width $1\frac{1}{4}$ mm.

Hab.—Q.: Cairns (type in Macleay Museum).

A small dingy species which at first sight appears to belong to *Melanterius* (it resembles such species as *maculatus*, *acaciæ* and *tristis*). The antennæ are decidedly aberrant, but it has not been considered necessary to generically isolate it on that account.

MECISTOCERUS DENTICULATUS Pasc.; Mast. Cat. Sp. No.5412.

Hab.—"Port Bowen" (Pascoe).

I am confident that I have not seen this species. The male is described as having a number of small spine-like teeth on the anterior femora and tibiæ.*

Genus BEROSIRIS Pascoe.

Journ. Linn. Soc. 1873, p.43.

Head small, convex, partially concealed. *Eyes* large, triangularly-ovate, widely separated above and moderately beneath, rather coarsely faceted. *Rostrum* long, thin and moderately curved. *Antennæ* thin; scape inserted nearer apex than base of rostrum and the length of funicle; club elongate-elliptic. *Prothorax* moderately or scarcely transverse, sides rounded, base bisinuate, apex produced, ocular lobes almost rectangular. *Scutellum* distinct. *Elytra* elongate-cordate, not much wider than prothorax. *Pectoral canal* moderately deep and narrow, terminated in metasternum. *Mesosternal receptacle* absent, the intermediate coxæ exposed internally. *Metasternum* slightly shorter than the following segment; episterna rather wide. *Abdomen* with the four basal segments drawn slightly backwards at the sides, the 1st almost as long as 2nd and 3rd combined, intercoxal process moderately wide and rounded, apical suture incurved; 3rd and 4th combined slightly longer than 2nd and considerably longer than 5th. *Legs* rather short; femora moder-

* Since this was written I have seen a male, and the spines of its femora and tibiæ render it very distinct.

ately stout, not grooved, dentate, posterior not extending to apex of abdomen; tibiæ short, compressed, the anterior bisinuate beneath; tarsi rather short, 3rd joint wide and deeply bilobed, 4th elongate. Elliptic, convex, squamose, non-tuberculate, winged.

Allied to the preceding genus, which it resembles in the long rostrum and exposed intermediate coxæ, but distinguished from it by the absence of a prosternal process between the four anterior coxæ. In *tanyrhynchus* the canal extends almost to the abdomen but it is entirely different in character from that of *Myrtesis*. The genus appears to be abundantly represented in the Malay Archipelago, but only one species has previously been recorded from Australia.

Pectoral canal terminated almost at abdomen.................. *tanyrhynchus*.
Pectoral canal terminated just behind intermediate coxæ... *mixtus*.

BEROSIRIS MIXTUS, n.sp.

Elongate-elliptic. Reddish-brown, antennæ paler. Densely clothed with fawn-coloured scales somewhat variable in shade, and with patches of sooty scales; scutellum nude. Under surface with rather pale scales except at sides and on the apical segments. Head and basal third of rostrum in ♂, basal fourth in ♀, with dense and rather dark scales.

Head with dense, round, concealed punctures. Rostrum thin, longer than prothorax and scutellum combined; in ♂ basal half with coarse concealed punctures, the apical half shining; in ♀ basal fourth only with rather coarse punctures. Scape inserted one-third from apex of rostrum in ♂ (two-fifths in ♀); 2nd joint of funicle as long as the 3rd and 4th combined, 1st and 3rd subequal. *Prothorax* moderately transverse, apex produced and less than half the width of base; with dense, round, concealed punctures. *Scutellum* oblong and shining. *Elytra* slightly wider than prothorax and about twice and one-half its length; with series of large, deep, oblong, more or less concealed punctures; interstices apparently much wider than punctures but really considerably narrower except posteriorly, the alternate ones very

feebly raised. *Under surface* with dense concealed punctures. Pectoral canal semicircularly encroaching on metasternum. Basal segment of abdomen feebly depressed in middle in ♂, convex in ♀. *Femora* stout, posterior not extending to apical segment, all acutely dentate; anterior tibiæ strongly bisinuate beneath, the others distinctly curved. Length 7¾, rostrum 2¼; width 3⅓ mm.

Hab.—Q.: Endeavour River (Macleay Museum).

Apparently close to *calidris* in general appearance, but the four basal joints of the funicle in that species are said to be short and subequal. The palest scales are on the elytra beyond the middle; there is a subtriangular sooty patch on each side of the prothorax at base (sometimes conjoined to form a subquadrate patch), on the elytra the sooty scales are more numerous from the basal fourth to near the middle. The scales are of a soft nature and appear to be easily discoloured. There are numerous specimens in the Macleay Museum.

BEROSIRIS TANYRHYNCHUS, n.sp.

♀. Elongate-ovate. Reddish-brown, antennæ paler. Densely clothed with muddy grey scales; prothorax with sooty scales except on each side of base; elytra with a large sooty patch terminating beyond the middle but not continued to shoulders. Femora obscurely ringed. Head and base of rostrum densely clothed.

Head with dense, round, concealed punctures. Rostrum longer than prothorax and scutellum combined, basal third with moderately coarse punctures, elsewhere shining. Scape inserted just perceptibly nearer apex than base of rostrum; two basal joints of funicle of equal length and not very long, the others transverse. *Prothorax* scarcely if at all transverse, apex produced but more than half the width of base, with dense concealed punctures. *Scutellum* rather indistinct. *Elytra* not much more than twice the length of prothorax and at base not much (but suddenly) wider, widest at about middle; punctures and interstices apparently as in the preceding species. *Under surface* with very dense concealed punctures. Pectoral canal extending almost to

abdomen, the tip of the rostrum actually resting on it. Basal segment of abdomen convex. *Femora* and tibiæ much as in the preceding species. Length 5, rostrum $1\frac{4}{5}$; width 2 mm.

Hab.—Q.: Endeavour River (Macleay Museum).

Differs from the preceding species in being much smaller and differently clothed, narrower and elongate-ovate, instead of almost perfectly elliptic, the scape inserted at a greater distance from apex of rostrum, the joints of the funicle differently proportioned and the rostrum touching the abdomen when at rest. Two female specimens are under examination.

BEROSIRIS CALIDRIS Pasc.; Mast. Cat. Sp. No.5563.

Hab.—"New Guinea; Somerset, Rockhampton" (Pascoe).

Mr. Pascoe describes the funicle as "articulis primis quatuor . . . . : subaequalibus," otherwise his description applies fairly well to *mixtus*.

MICROBEROSIRIS, n.g.

Head convex, not concealed. *Eyes* small, ovate, lateral, coarsely faceted. *Rostrum* not very long, but thin and curved. *Antennæ* rather thin; scape inserted nearer base than apex of rostrum; club briefly ovate. *Prothorax* transverse, sides rounded, base bisinuate, apex almost truncate, ocular lobes absent. *Scutellum* small. *Elytra* elongate-cordate. *Pectoral canal* not very deep and rather narrow, slightly encroached upon by anterior coxæ and terminated in metasternum. *Mesosternal receptacle* absent, the coxæ exposed. *Metasternum* slightly longer than the following segment; its episterna rather wide. *Abdomen* with the three intermediate segments drawn slightly backwards at the sides, the two basal segments rather large. *Legs* rather short and stout; femora edentate, not grooved, posterior not extending to apex of abdomen; tibiæ round, terminal hook obtuse; tarsi almost the length of tibiæ. Elliptic, convex, squamose, non-tuberculate, winged.

In appearance the minute insect described below approaches many of the *Erirhinidæ*. The pectoral canal appears to (if it

actually does not) extend to the abdomen. Seen from the sides, the prothorax appears to be obliquely truncate from the apex to the anterior coxæ so that the ocular lobes are really absent.

The position of the genus is by no means certain, but on account of its elongated canal and exposed intermediate coxæ it is placed after *Berosiris*.

MICROBEROSIRIS EXILIS, n.sp.

Blackish-brown, antennæ (club excepted) and rostrum (base excepted) paler. Densely and almost uniformly clothed (on rostrum at extreme base only) with white scales that almost completely hide the sculpture.

Head with dense concealed punctures. Rostrum long and thin; with rather strong punctures on basal half, apical half shining and lightly punctate. *Prothorax* feebly transverse, apex not much narrower than base; with dense concealed punctures. *Elytra* slightly wider than prothorax and but little more than twice as long, shoulders rounded, sides parallel to near apex; with series of concealed punctures; interstices regular. *Under surface* with dense concealed punctures; pectoral canal terminated almost at abdomen, but a feeble impression connecting it with abdomen itself. Length $1\frac{1}{3}$, rostrum $\frac{2}{3}$; width $\frac{3}{4}$ mm.

Hab.—W.A.: Swan River.

I have seen but one specimen of this minute insect, and in preparing it for examination damaged the funicle of both of its antennæ; in consequence only the club and scape could be described. Both genus and species, however, are remarkably distinct.

SYMPEDIOSOMA, n.g.

Head rather small, moderately convex, partially concealed. *Eyes* large, ovate, rather widely separated, coarsely faceted. *Rostrum* rather long and thin, distinctly curved, sides distinctly incurved to middle. *Antennæ* rather thin; scape shorter than funicle, inserted in middle of rostrum; two basal joints of funicle elongate; club elliptic-ovate. *Prothorax* transverse, base bisinuate, apex strongly narrowed, constriction feeble, ocular lobes obtuse. *Scutellum* distinct. *Elytra* subcordate, not much (and not

suddenly) wider than prothorax, base trisinuate. *Pectoral ca* deep and narrow, terminated between intermediate coxæ. *M sternal receptacle* feebly raised, U-shaped; slightly cavern *Metasternum* about three-fourths the length of the following ment; episterna rather wide. *Abdomen* with the 1st segmen long as 2nd and 3rd combined, intercoxal process rounded, a slightly incurved; 3rd and 4th drawn slightly backward sides, their combined length slightly more than that of 5th less than that of 2nd. *Legs* rather short; femora feebly rid and dentate but not grooved, posterior not extending to ape abdomen; tibiæ compressed and lightly curved; tarsi nor Oblong-elliptic, moderately convex, squamose, winged.

The genus differs from *Cryptorhynchus* principally in elytra, abdomen, and tibiæ. It is closely related to the Zealand genera *Tychanus* and *Sympedius;* from the forme may be distinguished by the U-shaped mesosternal receptacle the comparatively long metasternum; from the latter by insertion of scape and the curved tibiæ. Mr. Pascoe descr the femora of *Sympedius* as unarmed, but in *vexatus* they comparatively strongly dentate, although the teeth are not vis from in front; even from behind in *testudo* the anterior fem may be seen to be minutely dentate. Mr. Pascoe compares genera with *Acalles,* a genus with which they have few charac in common.

Rostrum distinctly wider at base than at apex.......... ... *albifrons.*
Rostrum no wider at base than at apex..................... .... *obliquifascia*

SYMPEDIOSOMA ALBIFRONS, n.sp.

Reddish-brown. Densely clothed with soft mouse-colou scales (paler and smaller on elytra than on prothorax); ape prothorax with a large transverse patch of white scales; el with a moderately distinct median fascia of white scales an scarcely traceable one posteriorly, between them two very fe dark fasciæ. Under surface with dense, round, soft, pale sc denser on metasternum than elsewhere; legs feebly variega Head and base of rostrum with dense mouse-coloured scales.

Head with concealed punctures. Rostrum slightly longer than prothorax, base considerably wider than apex; basal fourth rather strongly punctate, elsewhere shining and impunctate. First joint of funicle slightly longer than 2nd, 4th-7th transverse. *Prothorax* rather strongly transverse, posterior angles scarcely produced; with dense concealed punctures and with small scattered granules. *Elytra* about twice and one-third the length of prothorax; striate-punctaté, punctures concealed; interstices separately convex, wider than striæ, the 3rd rather distinctly raised at base, all (but more noticeably those nearest to the suture) with minute shining granules. *Under surface* with dense, regular, partially concealed punctures. *Femora* minutely dentate. Length $6\frac{1}{2}$, rostrum $2\frac{1}{8}$; width $3\frac{1}{2}$ mm.

Hab.—Q.: Endeavour River (Macleay Museum).

Of the two specimens under examination one has the derm of an almost uniform reddish-brown, the other is somewhat paler, with the rostrum, antennæ and legs still paler. The paler specimen has the clothing as described, but on the darker one the markings are less distinct.

SYMPEDIOSOMA OBLIQUIFASCIATUM, n.sp.

Reddish-brown, antennæ dull red. Very densely clothed with soft pale fawn-coloured scales, and with a very distinct fascia of paler scales extending from each shoulder to near the suture slightly before the middle. Under surface with pale scales varying from thin to almost perfectly circular, and dense in some places and sparse in others; legs with dense scales the colour of those on prothorax, but with white ones rather thickly distributed. Head and base of rostrum with darker scales than elsewhere, but the former with a feeble median line of paler scales.

Head with concealed punctures. Rostrum the length of prothorax, apex as wide as base, sides rather strongly incurved to middle; basal third and basal half rather strongly punctate, elsewhere shining and minutely punctate First joint of funicle slightly longer than 2nd. *Prothorax* strongly transverse, sides rather suddenly narrowed at apical third, posterior angles pro-

duced; with dense concealed punctures and scattered shining granules. *Elytra* scarcely more than twice the length of prothorax; striate-punctate, punctures concealed; interstices separately convex, wider than punctures, with rather numerous small shining granules becoming smaller posteriorly. *Under surface* with dense, regular, partially concealed punctures. *Femora* minutely dentate. Length 4, rostrum 1¼; width 2 mm.

Hab.—Q.: Barron Falls (Mr. A. Koebele).

The granules, especially on the elytra, show up very distinctly despite the density of the clothing.

Genus Imalithus, Pascoe.

Journ. Linn. Soc. 1869, p.465.

Head rather large, slightly convex, entirely concealed from above. *Eyes* rather small, ovate, lateral, coarsely faceted. *Rostrum* rather short and wide, almost straight. *Antennæ* rather stout; scape inserted nearer base than apex of rostrum and much shorter than funicle; club ovate. *Prothorax* transverse and semicircular. *Scutellum* small. *Elytra* closely applied to and their outline continuous with that of prothorax. *Pectoral canal* deep and wide, terminated between anterior coxæ. *Mesosternal receptacle* large, sides incurved near base, base truncate, emargination widely transverse; cavernous. *Metasternum* longer than the following segment; episterna distinct. *Abdomen* with straight sutures; 1st segment as long as 2nd and 3rd combined, intercoxal process rather wide; 3rd and 4th with deep and wide sutures, their combined length equal to that of 2nd and slightly more than that of 5th. *Legs* short; femora stout and wide, posterior not extending to apex of abdomen, grooved and edentate; tibiæ compressed; tarsi rather short but thin, 3rd joint not very wide. Oblong-elliptic, greatly depressed, squamose, winged.

A remarkable genus, the true position of which is very doubtful. Mr. Pascoe regarded it as allied to *Acalles*, but the metasternum is decidedly elongate, its episterna distinct and rather wide, and the body winged. I may be wrong in placing it with the true

Cryptorhynchides rather than amongst the allies of *Chætectetorus*. Its connection with *Acalles*, however, is certainly very remote.

IMALITHUS PATELLA Pasc.; Mast. Cat. Sp. No.5482.

Black, antennæ dull reddish-brown. Densely clothed with stout, muddy-brown scales, paler and smaller on under than on upper surface.

Punctures everywhere concealed, but apparently dense. *Rostrum* slightly shorter than prothorax, sides lightly incurved to middle. *Prothorax* depressed in middle, margins strongly raised and semicircular, each distinctly notched in middle. *Elytra* flattened along middle; 5th interstice largely and suddenly raised and somewhat curved, the raised portion becoming subtuberculate posteriorly and terminated at apical fourth, 7th interstice slightly raised and posteriorly with a number of rather large fasciculate tubercles, 9th interstice curved and slightly raised. Length 5½, rostrum 1¼; width 3¼ mm.

Hab.—N.S.W.: "Clarence River" (Pascoe); Q.: Wide Bay (Australian and Macleay Museums).

An easily recognisable species.

PARATITUACIA, n.g.

Head rather large, feebly convex, partially concealed. *Eyes* small, ovate, lateral, very finely faceted. *Rostrum* wide but not very short, moderately curved. *Scape* inserted closer to base than apex of rostrum, distinctly shorter than funicle; two basal joints of the latter moderately long; club elliptic-ovate. *Prothorax* briefly subconical, base bisinuate, constriction feeble but continued across summit, ocular lobes very obtuse. *Scutellum* small. *Elytra* briefly cordate, base wider than prothorax and each separately rounded. *Pectoral canal* deep and wide, terminated between intermediate coxæ. *Mesosternal receptacle* feebly raised, crescent-shaped, emargination moderately transverse; cavernous. *Metasternum* not much shorter than the following segment; episterna distinct. Basal segment of *abdomen* as long as the two following combined, intercoxal process rather wide

but rounded, apex incurved; 2nd-4th drawn slightly backwards at sides; 3rd and 4th combined the length of 5th and slightly shorter than 2nd. *Legs* moderately long; femora sublinear, not grooved, edentate, posterior not extending to apex of abdomen; tibiæ rather stout and almost straight, tarsi normal. Briefly ovate, convex, squamose, winged.

A distinct genus which might be regarded as allied to *Chætectetorus*, but which is placed here on account of most of its characters. From *Cryptorhynchus* it differs in the very finely faceted eyes, in the legs and basal segments of abdomen; *Tituacia*, to which on first sight it is rather close, differs in having coarsely faceted eyes, elytra not much wider at the base than prothorax, metasternum very short and the body apterous.

PARATITUACIA DORSOSIGNATA, n.sp.

Black or blackish-brown, antennæ dull red, club darker. Clothed with white scales feebly variegated with ochreous, and with a very large and sharply defined patch of black scales commencing at apex of prothorax and terminating beyond middle of elytra. Under surface and legs with pure white scales. Head (except at extreme base) and rostrum with black scales.

Head with dense concealed punctures. Rostrum the length of prothorax, sides incurved to middle; densely and rather coarsely punctate throughout and with a feeble median ridge on basal half. *Prothorax* moderately transverse, sides rounded, apex less than half the width of base; with dense, round, clearly cut but concealed punctures. *Elytra* not much (but suddenly) wider than prothorax, and about twice as long; with series of moderately large but almost entirely concealed punctures; interstices wider than punctures, the 3rd and 5th each with two very feeble tubercular elevations. *Under surface* with dense concealed punctures. Posterior *femora* not quite extending to middle of apical segment. Length 3¾, rostrum 1; width 2; variation in length 3-3¾ mm.

Hab.—W.A.: Swan River, Chidlow's Well, Geraldton.

The large black patch of the upper surface has an almost triangular outline; on one specimen, however, this triangle, though traceable, consists of slightly variegated and not much darker scales than elsewhere, whilst the scales on its head and rostrum are of a dingy greyish-white. Of the (six) specimens under examination, two were taken with the sweep net, two were beaten from a common *Acacia*, one was taken from the stomach of a magpie, and the other was received from the Australian Museum without label, but was probably taken by Mr. Masters at King George's Sound.

Genus NECHYRUS, Pascoe.

Journ. Linn. Soc. 1871, p.203.

As this genus is numerously represented in the Malay Archipelago and but sparingly in Australia, I have not considered it advisable to give a formal generic diagnosis, which of necessity could be based on but few Australian species. The main features of the genus, however, appear to be the small head, small and finely faceted eyes, long and thin rostrum, short scape, small but distinct scutellum, open mesosternal receptacle, and soldering together of two basal segments of abdomen.

The Australian species may be thus tabulated:—

Femora edentate..	*legitimus*, n.sp.
Femora dentate.	
Scape almost the length of funicle........................	*latipennis*, n.sp.
Scape much shorter than funicle.	
Prothorax slightly transverse.................................	*incomptus*, Pasc.
Prothorax slightly wider than long..........................	*mollipes*, n.sp.

NECHYRUS INCOMPTUS Pasc.; Mast. Cat. Sp. No.5566.

Depressed, elliptic-ovate. Black, opaque; antennæ dull dark red; rostrum shining. Densely clothed with ferruginous-brown scales which are rounded in shape and not closely applied to derm, they are largest on the prothorax, at the apex of which they are paler and bifasciculate; elytral tubercles fasciculate. Under surface with sparser scales than upper; tibiæ with stout brownish and sooty setæ or elongate scales, claw-joint with a few distinct setæ.

Head small, round, convex; densely and rather coarsel
tate; ocular fovea not traceable. Rostrum long, thin,
towards base coarsely punctate and irregularly costate,
apex with sparse elongate punctures. Antennæ mo
stout; scape short, about the length of three basal j
funicle, inserted slightly closer to base than apex of rostru
basal joints of funicle moderately long, subequal, almost th
of the rest combined; club ovate. *Prothorax* (by measu
slightly wider than long, flat except for a few feeble tube
in middle, sides rounded, towards apex strongly coarcta
less than half the width of base; with moderately large
punctures (in fresh specimens almost concealed
Scutellum small and transverse. *Elytra* flatten
vertical; posterior declivity rather abrupt;
scarcely twice the length of prothorax; irregular
foveæ in places subgeminate, towards the sides
each with three series of moderate ge but
the 2nd, 4th and 6th interstices re vely th plac
the posterior declivity is crowne four erse
and there is a similar series bef hould
tuberculate. *Pectoral canal* mo
near base of intermediate coxæ
segment of abdomen, its epist
Abdomen with scattered larg
than 2nd, intercoxal process
ment transversely and large
three apical segments flat,
combined. *Legs* rather lo
passing elytra; each with a
by scales. Length 8, ros
7 9 mm.

Hab.—"Queensland" (
Rivers (Lea).

Appears to be somew
the elytral foveæ, th
account of clothing;
regular, but are usua

NECHTERUS BULLIPES, n.sp. or var.

Very close to the preceding; differs in having the antennæ inserted closer to base of rostrum, prothorax slightly longer than wide, apex half the width of base; elytral foveæ still more irregular, the tubercles smaller, a series before, at, and below summit of posterior declivity; under surface with larger punctures and scales; and the posterior femora more acutely and strongly dentate than the others. Length 8½, rostrum 2½; width 3½ mm.

Hab.—N.Q.: Barron Falls (Mr. A. Koebele).

Perhaps but a var[illegible] *incomptus*; I have but one specimen [illegible]ge from.

[illegible]ATIPENNIS, n.sp.

[illegible]ck, antennæ [illegible]sely (on under surface sparsely) [illegible]ed with fawn [illegible]ales, a small but very distinct spot [illegible]hite scales on [illegible]f elytra (on 3[illegible]ce) at apical [illegible]l. Head an[illegible]l of rostrum [illegible]sely clothed. [illegible]thorax with [illegible]istinct fas[illegible] with twelve [illegible] distinct (t[illegible]he 3rd an[illegible]es) and some [illegible]ller fascicle[illegible]

[illegible]ead with [illegible]d punct[illegible]um moderately [illegible]d, con[illegible]r than [illegible]asal half with [illegible]e conc[illegible], apical [illegible]hining and with [illegible]rately [illegible] punc[illegible] inserted slightly [illegible]r ap[illegible]strum [illegible]e length of funicle; [illegible]join[illegible]ghtly [illegible]he 2nd, the others [illegible]glob[illegible]rans[illegible]*ax* moderately trans-[illegible]d[illegible]ime[illegible]d one-half the width [illegible]on[illegible]es; feebly tuberculate [illegible] median carina. *Elytra* [illegible]f the width and almost [illegible]eries of large partially con-[illegible], becoming smaller on the [illegible]arrower than punctures and [illegible] tubercles beneath[illegible]

Head small, round, convex; densely and rather coarsely punctate; ocular fovea not traceable. Rostrum long, thin, curved; towards base coarsely punctate and irregularly costate, towards apex with sparse elongate punctures. Antennæ moderately stout; scape short, about the length of three basal joints of funicle, inserted slightly closer to base than apex of rostrum; two basal joints of funicle moderately long, subequal, almost the length of the rest combined; club ovate. *Prothorax* (by measurement) slightly wider than long, flat except for a few feeble tuberosities in middle, sides rounded, towards apex strongly coarctate, apex less than half the width of base; with moderately large shallow punctures (in fresh specimens almost concealed by clothing). *Scutellum* small and transverse. *Elytra* flattened, sides almost vertical; posterior declivity rather abrupt; wider than and scarcely twice the length of prothorax; irregularly seriate-foveate, foveæ in places subgeminate, towards the sides becoming regular; each with three series of moderately large but obtuse tubercles; on the 2nd, 4th and 6th interstices respectively these are so placed that the posterior declivity is crowned with four in a transverse series, and there is a similar series before the summit; the shoulders are tuberculate. *Pectoral canal* moderately wide and deep, terminated near base of intermediate coxæ. Metasternum shorter than basal segment of abdomen, its episterna (which are very narrow) longer. Abdomen with scattered large punctures, basal segment longer than 2nd, intercoxal process rounded and very wide; 2nd segment transversely and largely excavated but not to the sides; three apical segments flat, the apical longer than 3rd and 4th combined. *Legs* rather long; femora not clavate, posterior just passing elytra; each with a small tooth which is almost concealed by scales. Length 8, rostrum 2½; width 4; variation in length 7-9 mm.

Hab.—"Queensland" (Pascoe); N.S.W.: Tweed and Richmond Rivers (Lea).

Appears to be somewhat variable in regard to size and clothing; the elytral foveæ, though large, are sometimes indistinct on account of clothing; they are all sometimes perfectly round and regular, but are usually here and there conjoined.

NECHYRUS MOLLIPES, n.sp. or var.

Very close to the preceding; differs in having the antennæ inserted closer to base of rostrum, prothorax slightly longer than wide, apex half the width of base; elytral foveæ still more irregular, the tubercles smaller, a series before, at, and below summit of posterior declivity; under surface with larger punctures and scales; and the posterior femora more acutely and strongly dentate than the others. Length 8½, rostrum 2½; width 3½ mm.

Hab.—N.Q.: Barron Falls (Mr. A. Koebele).

Perhaps but a variety of *incomptus*; I have but one specimen to judge from.

NECHYRUS LATIPENNIS, n.sp.

Black, antennæ red. Densely (on under surface sparsely) clothed with fawn-coloured scales, a small but very distinct spot of white scales on each side of elytra (on 3rd interstice) at apical third. Head and basal third of rostrum rather densely clothed. Prothorax with four very distinct fascicles, elytra with twelve very distinct (three each on the 3rd and 5th interstices) and some smaller fascicles.

Head with dense concealed punctures. Rostrum moderately curved, considerably longer than prothorax; basal half with coarse concealed punctures, apical half feebly shining and with moderately small but dense punctures. Scape inserted slightly nearer apex than base of rostrum and almost the length of funicle; 1st joint of the latter slightly longer than the 2nd, the others subglobular, 7th lightly transverse. *Prothorax* moderately transverse, base distinctly bisinuate and once and one-half the width of apex; with dense concealed punctures; feebly tuberculate beneath fascicles and with a feeble clothed median carina. *Elytra* oblong-cordate, about once and one-half the width and almost thrice the length of prothorax; with series of large partially concealed and not very close punctures, becoming smaller on the sides and posteriorly; interstices narrower than punctures and not separately convex, with small tubercles beneath fascicles.

Under surface with sparse and small punctures except on sides, where, however, they are more or less concealed. *Femora* acutely and very distinctly dentate. Length 8¼, rostrum 2½; width 4½ mm.

Hab.—N.S.W.: Clarence River (Macleay Museum).

The two white spots on the elytra, though small, are very distinct; the femoral teeth are of considerable size. The outlines of this and the following species are very different from those of the two preceding.

NECHYRUS LEGITIMUS, n.sp.

Black, antennæ red. Densely clothed (not much sparser on under than on upper surface) with brownish-fawn scales, becoming sooty-brown on head and basal third of rostrum and very dense on legs. Upper surface with distinct but not strongly elevated sooty-brown fascicles, four on prothorax across middle (two very indistinct ones on apex, and about ten on elytra; of these eight are on the 3rd interstices but not confined to them.

Head with dense concealed punctures. Rostrum lightly curved and moderately wide, the length of prothorax; punctures at basal fourth concealed, elsewhere shining and with moderately large but not crowded punctures. Scape inserted two-fifths from apex of rostrum and almost the length of funicle; 1st joint of the latter slightly longer than the 2nd, the two combined slightly more than half its total length, 3rd-5th subglobular, 6th strongly, 7th very strongly transverse. *Prothorax* feebly transverse, base bisinuate and twice the width of apex; with rather coarse but almost concealed punctures; feebly tuberculate beneath fascicles and with a scarcely traceable median carina. *Elytra* subcordate; once and one-fourth the width and not much more than twice the length of prothorax, base trisinuate, shoulders rounded; with series of large, round punctures, not very close together and becoming smaller posteriorly; interstices narrower than punctures, and not separately convex, feebly tuberculate beneath fascicles. *Under surface* with dense, moderately large and partially concealed punctures. *Femora* edentate, posterior passing elytra. Length 6½, rostrum 1½; width 3½ mm.

[Printed off August 16th, 1907.]

Hab.—New South Wales (type in Macleay Museum).

The shape is somewhat as in the preceding species, but the clothing is very different (although the fascicles are almost in the same positions), the femora are edentate and the rostrum is much shorter. Although Mr. Pascoe in describing the genus notes the femora as edentate, this is the only species here described in which such is the case.

Genus SYBULUS Pascoe.

Journ. Linn. Soc. 1871, p.202.

The species described below certainly belongs to the genus *Sybulus*, now first recorded from Australia, but as Mr. Pascoe states that at least six species of the genus occur in the Malay Archipelago, and he describes the femora as being uni- or bidentate, I have not thought it advisable to give a generic diagnosis based on but one Australian species. The chief generic features of this species, however, are its large and coarsely faceted eyes, long and thin rostrum, longish subcylindrical club, the sutures of which are oblique, U-shaped and slightly cavernous mesosternal receptacle and distinctly bidentate femora. There appears to be no closely allied genus in Australia; Mr. Pascoe regarded it as being allied to *Pezichus*, but its connection with that genus is decidedly remote.

SYBULUS YORKENSIS, n.sp.

Black, antennæ of a rather light red, club darker. Rather densely clothed with scales varying from white to dingy black, but the majority of a rather dark fawn, scales larger and more rounded on prothorax than on elytra. Under surface moderately clothed with whitish scales; legs densely clothed with dingy scales. Head and base of rostrum with feebly variegated scales.

Head with dense concealed punctures. Rostrum longer than prothorax, rather strongly curved, thin and feebly decreasing in width from base; basal fifth strongly punctate, elsewhere highly polished and impunctate. Scape inserted nearer base than apex of rostrum and shorter than funicle; two basal joints of funicle

moderately long and subequal in length, 3rd and 4th each slightly longer than wide, 5th-7th globular; club almost the length of five preceding joints. *Prothorax* rather strongly transverse, sides strongly rounded, base bisinuate and almost twice the width of apex, which is but feebly produced; with dense, round, partially concealed punctures. *Scutellum* distinct, in the centre of a depression. *Elytra* slightly wider than prothorax and scarcely twice and one-half wider; with series of rather large and partially concealed punctures; interstices not much wider than punctures, not alternately raised, with small and shining but frequently concealed granules. *Under surface* with distinct but not very dense punctures. Metasternum slightly shorter than the following segment; its episterna rather wide and each with a single series of punctures. Abdomen with straight sutures; 1st segment almost the length of 2nd and 3rd combined, intercoxal process narrow, 2nd the length of 5th and just perceptibly longer than 3rd or 4th. *Legs* not very long; femora grooved, strongly acutely and equally bidentate, posterior not extending to apical segment; tibiæ strongly compressed and falcate; tarsi not very wide, 4th joint thin, claws small. Length $5\frac{1}{4}$, rostrum $1\frac{3}{8}$; width $2\frac{3}{8}$ mm.

Hab.—Q.: Cape York (Macleay Museum).

Differs from the description of *peccuarius* (from Batchian) in being smaller, the 1st joint of the funicle longer than the 3rd, and the prothorax without four white spots across the middle and one at apex.

DERBYIA Lea. Proc. Linn. Soc. N. S. Wales, 1899, p.543.

I have to thank Messrs. Etheridge and Rainbow for calling my attention to the fact that this name, although not appearing in Scudder, had been previously used* for a genus of fossils. As a substitute therefore for the genus of weevils, I propose the name *Derbyiella*.

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* Palæontologia Indica, Vol. i., p.591.

A CONTRIBUTION TO THE GEOLOGY OF VITI LEVU, FIJI.

By W. G. Woolnough, D.Sc., F.G.S., Assistant Lecturer in Geology and Mineralogy, University of Sydney.

Contents.

Introduction.

In January and February, 1901, at the suggestion of Professor J. W. Judd, F.R.S., and with Professor David's permission, I spent about six weeks in exploring geologically the central portion of Viti Levu, the main island of the Fiji Group. The results of that expedition were published in the Proceedings of this Society (Vol. xxviii. 1903, pp. 457-496, 500-540, Plates xxii.-xxxvi.).

Note.—I have given all names as they are spelt in Fiji because of the difficulty I have had in getting natives to locate places if the spelling is Anglicised. The language is phonetic; the vowels have the French values, double vowels are true diphthongs. Of the consonants b = mb, c = th (as in that), d = nd, g = ng (soft), q = ng-g (hard). The accent in simple words is usually on the penultimate, sometimes on the last syllable.

With the assistance of Professor Judd, a grant of seventy pounds was obtained from the Royal Society of London in 1903, and a further grant of eighty pounds in 1904. This liberality enabled me to carry out a much longer and better equipped expedition during the early part of 1905, when I was able to spend almost three months in central Viti Levu. My best thanks are also due to the Senate of the University of Sydney for allowing me three months' leave of absence from the date of my appointment to the teaching staff.

To Professor David I owe more than can ever be expressed for his whole-hearted sympathy and ready advice at every point of the undertaking.

In Fiji the success of the expedition was entirely due to the assistance and advice of Dr. J. B. Corney, Chief Government Medical Officer. He gave us the benefit of his unequalled knowledge of the people, the country, and the conditions of work; and at great personal inconvenience was always ready with advice and help. No man has travelled so widely in Viti Levu, and during his journeys he always noted natural objects with true scientific acumen; even where his notes were fragmentary and he had to depend on his memory for facts observed years previously, we never found his observations in error. Enough cannot be said of his assistance to the expedition.

I was fortunate enough in securing the services of Mr. E. J. Goddard, B.A., B.Sc., Junior Demonstrator in Biology, University of Sydney, as assistant. Throughout all the difficulties and dangers of the trip he proved himself a loyal and courageous companion, and I desire to express to him my thanks.

Through the good offices of Mr. Thomas Steel, F.L.S., the Directors of the Colonial Sugar Refining Company were good enough to give general directions to all their managers in Fiji to help me where possible. This request was most liberally interpreted, and to all concerned my grateful thanks are hereby rendered.

Other acknowledgments will be made below.

NARRATIVE.

Leaving Suva on 6th January, 1905, we proceeded up the Rewa River to Nausori. Mr. R. Gemmel Smith, general manager for Fiji of the Colonial Sugar Refining Company, extended his hospitality and afterwards very kindly allowed the expedition to travel to Bau Levu by the stern-wheel river-boat belonging to the Company. At Bau Levu we were hospitably entertained by Mr. Freeman. On Saturday night a hurricane commenced to blow, and lasted until the middle of Sunday afternoon, but fortunately heavy rain did not fall in the Rewa Valley, so that the river did not come down in heavy flood.

Dr. Corney had, through the kindness of Mr. Joske, Commissioner for Colo East, etc., been able to arrange for a large canoe to meet us at Bau Levu, so that we were able to start up stream again early on Monday morning. The canoe was not able to carry all our goods, so that we had to arrange for another one to follow us with the excess. We travelled by canoe as far as Naivucini on the Wainimala. While waiting for the second canoe, we ascended Nacau, a mountain overlooking the town.

We then travelled southwards to Nabukaluka, on the Waidina River, and made the ascent of Nabukelevu, spending a night on the summit. Returning to Naivucini, we were met by a train of pack bullocks arranged for by Mr. Joske. These, with a party of native porters, carried our goods through a long day's journey to Narokorokoyawa on the Upper Wainamala, at which town we had decided to make our headquarters.

A few days were spent working in the neighbourhood of the town. On 23rd January we set out to cross the high plateau of Navosa. This took us two days of exceptionally hard travelling. The climb on to the plateau is about 2000 feet, and the surface of the plateau is simply a morass. After floundering through this for miles, we were overtaken by a heavy thunderstorm, converting the streams into raging torrents which it was impossible to cross. We were delayed for a considerable time waiting for one of these to subside, and, after crossing it, reached the western

edge of the plateau, overlooking the valley of the Sigatoka River just as night was falling. After descending about 1500 feet over slippery soapstone, we found the Sigatoka in moderate flood, and were unable for some time to find a means of rounding a precipitous bluff and reaching the town of Namoli. We finally accomplished this by wading through the flood-water, and arrived in the town after seventeen hours' heavy travelling. We travelled down the river to Natuatuacoko and returned to Narokorokoyawa *via* Waibasaga, Vunatoto, Naduta and Korolevaleva.

On 30th January I started alone to revisit the Waidina Valley, leaving Mr. Goddard to carry on his biological work at Narokorokoyawa. I was forced to return to Suva to obtain boots, but returned to Narokorokoyawa by way of the Wainivalau Valley, crossing a track which has not, I believe, been traversed by another white man.

On February 10th I left Narokorokoyawa for Nadarivatu *via* Vatuvula, Nubumakita and Nasoqo, and arrived there 15th February. Mr. Goddard and I left again, in company, on 18th, and reached Nadrau on Upper Sigatoka. Thence we proceeded to Vuniwaiwaivula at the junction of the Wailoa and Rewasau Rivers, and went on to Udu at the junction of the Wailoa and Wainimala Rivers. Here we were delayed for a day by a heavy flood, and were enabled to reach our headquarters next day only through the marvellous resourcefulness of our head man Pita Caginicolo.

We returned to Suva by the same route traversed on the up journey. We were again indebted to Mr. Freeman for hospitality, and also for the loan of his boat and crew to take us to Nausori, where we caught the steamer for Suva.

On arriving at the capital we found that there was no news of the "Pilbarra," and it was surmised that she had broken down. I therefore cabled to the Registrar of the University of Sydney requesting an extension of leave for an extra fortnight. This having been granted, I set out with Mr. C. A. Holmes, Mr. Goddard being ill, to attempt the ascent of Korobasabasaga in the hope of gaining considerable information from the bird's-eye

view obtainable from its summit. As we could not obtain guides, we were forced to give up the attempt. We therefore followed the Waidina River to its source, crossed into the Wainikoroiluva Valley, and followed it and the main Navua River to Navua, thence returning to Suva.

With a longer time at my disposal, a much improved equipment, and a fair working knowledge of the language, and with the results of my former expedition as a basis upon which to work, I have been able to add considerably to the work done previously. Even now I can claim only that a general idea of the geological structure of Viti Levu has been obtained; the salient facts are correct, but the details are subject to modification by future observations. It is only natural that my earlier work requires extensive revision. On the whole, the results of my second exploration of Viti Levu have confirmed the main conclusions formed by me after my first exploration there, but there are several very important alterations which must be made in it. These will be noted in their proper place.

Summary of Results of Previous Expedition.

In my previous paper* I showed that while the main bulk of the island of Viti Levu is built up of andesitic and basaltic lavas and tuffs, "soapstones," and upraised coral reefs, there are nevertheless extensive areas of granitic and slaty rocks. Granitic and slaty rocks being practically confined to continental areas, I sought to show reason why Fiji should be considered as continental in origin.

The continental rocks were met with in the very centre of the island, extending from Wainiveidro on the upper Wainikoroiluva River to near Udu on the upper Wainimala River, a distance of upwards of thirty miles by track. Slaty rocks were met with near Namoli (called in error Nalaba) on the Sigatoka River, and examination of the river gravels of the island indicated a wide range of distribution for similar rocks.

* These Proceedings, 1903, Vol. xxviii. pp.457-496, 500-540, Plates xxii.-xxxvi.

Fossiliferous limestones of Middle Tertiary Age were met with at Walu Bay, Suva, and at Tawaleka, Sigatoka River. An immense mass of dense white limestone occurs at Naqalimare, on the Sigatoka, but has yielded no fossils.

The volcanic rocks were divided into a southern andesitic series and a northern basaltic series, each associated with tuffs and agglomerates, and giving rise to extremely rugged mountainous country.

The "soapstone" is an almost ubiquitous rock. As its name implies, it is a fine-grained, unctuous rock. It is stratified, the bedding generally being nearly or quite horizontal. I believe it to be a redistributed volcanic tuff deposited under marine conditions. At Nasoqo it has yielded marine fossils and waterworn boulders of granite, and at Nadrau marine fossils. The former place stands at an altitude of over 800 feet above sea-level, and the latter place at over 1200 feet, so that we have evidence of elevation of the land to the extent of at least 1200 feet during Cainozoic time.

I failed to find any conclusive evidence of folding or faulting connected with the movements which, I assumed, had isolated Fiji from the continental areas to the west, but thought that there was possible evidence of a fault at Nadarivatu.

GEOLOGICAL OBSERVATIONS.—*Plan of subdivision.*

For convenience I shall divide the area examined into several geographical districts, and describe these in order. These districts are indicated by numerals on the sketch plan (fig.1).

It must be understood that this division is one of convenience only and has nothing whatever to do with the official partition of the island into provinces and districts.

i.—*Rewa District (including the Lower Wainimala, Waidina, and Waimanu Rivers).*

The Rewa Delta and the lower Wainimala were described to some extent in my former paper. At the upper end of the steamer channel through the mangrove belt of the delta, where the channel joins the main river, it was noticed that a bar of reef limestone was being blown up to deepen the channel. I

could not obtain specimens, but judging from appearances it consists of the ordinary reef material; it was situated at a depth of about three feet below low-water mark. This point is about three miles from the present edge of the mud flat and five miles

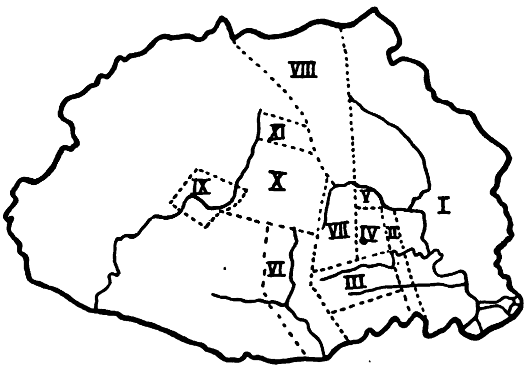

Fig.1.—Index Map of Viti Levu showing the relative positions, but not the absolute boundaries of the districts discussed in this paper. i.The Rewa Area, ii.The Medrausucu Range, iii.Upper Waidina and Waimanu Valleys, iv.Wainivalau Valley, v.Waiqa Valley, vi.Navua-Wainikoroiluva Valley, vii.Wainimala Valley, viii.Wailoa-Nadarivatu District, ix.Muanivatu District, ix.Navosa Plateau.

from the existing reef of Nukulau Passage. Its presence proves that there has been a considerable seaward advance of the river sediments, and that, for a long time, present conditions of level have not been altered to any great extent, a fact borne out by an examination of river history in the upper portions of the valley.

The high level soapstone near Naduruloulou noted before* proves to be of great interest and importance. There is evidence that there formerly extended over the whole of the area now occupied by the upper portion of the delta a continuous sheet of estuarine deposits with lignitic bands. These are now represented by isolated hills about Nausori, and more continuous areas higher up in the neighbourhood of Naduruloulou. They rise to a height of about 100 feet above the surface of the present river flats, indicating an elevation of this portion of the island since the beds were deposited. Passing northwards and westwards

* *Loc. cit.* p.464.

the level of these soapstone hills gradually rises until an elevation of from 300 to 500 feet is attained. Everywhere that I have examined sections of this formation in the district under consideration, I have found the beds to lie almost level, except towards the western boundary, where, close to the mountains, steeper dips have been observed. In a small creek (Nadirubasaga) between the Nadakuni and Wainiwaqa a dip of 15° to the east was obtained. Above Serea on the Wainimala the dip is E.N.E. at 8°.

It is quite possible that, in the case of these inclined beds, we are dealing with tuffs derived from the volcanic mountains which lie immediately to the west, and not with true "soapstones." Near Qelidranitaki (south of Serea) this conclusion is rendered probable by the fact that the dipping beds contain fragments of older and finer soapstone up to 4 inches in diameter.

Viewed from high points in the Medrausucu Range the area occupied by the level-bedded soapstones appears almost perfectly level, and seems to extend in an unbroken plain right away to the east coast of the island. There are, I believe, a number of deep, narrow river valleys east of the Rewa; their positions are, however, uncharted.

The area is a plain of marine accumulation uplifted with very little disturbance of the bedding. The fact that the track going south from Serea rises by a series of gentle slopes and falls by a series of steep scarps, suggests a gentle northerly dip, but lack of rock exposures and dense tropical jungle prevent direct observation.

A few isolated points rise above the general level of the plain. It is possible that these may represent the residuals of an older level at an elevation between 700 and 1,000 feet, but data are wanting.

With the elevation of the soapstone plain the rivers entered upon a cañon cycle. The rocks, consisting as they do of alternate relatively hard and soft beds of soapstone, produce a structure favourable to rapid recession of the streams. Even so, the fact that the first trace of a rapid in the Wainibuka is at least 30

miles from the top of the delta, and over 40 from the sea, proves that the elevation is not an extremely recent one. The evidence of the reef at the river mouth has already been commented on.

From Viria onwards the river valley becomes practically a gorge. No very extensive patches of alluvial are met with, and the soapstone cliffs rise to heights of 200 to 300 feet almost from the water's edge. The smaller tributary valleys do not enter the river "at grade" but yield cascades falling into the main stream. Even moderately large creeks are interrupted by picturesque waterfalls at no great distance above their junctions with the river. The larger tributaries are at grade. The small valleys have thus the character of hanging valleys, and indicate the youthfulness of the stream.

I followed the Wainibuka a little above the junction of the Wainimala in order to examine the nature of the gravels brought down by the former stream, but found that there were none. The natives informed me that this river is singularly destitute of gravel for a very considerable distance. This shows that the whole of the country drained by it is a continuation of the soapstone plain, uninterrupted by areas of volcanic or plutonic rock.

In the Wainimala, up to the town of Serea, level-bedded soapstones similar to those described above, form the banks, but, unlike the Wainibuka, there are extensive and varied gravels consisting of rock types met with *in situ* further to the west.

Above Serea strongly marked dips are encountered in the soapstones (*vide* p.438).

I searched carefully for fossils in all the soapstones, but found very few traces of macroscopic organisms. The lignified plant stems of Naduruloulou were referred to in my last paper. In addition to these, ill-defined plant fossils were found just above the first rapid of the Wainibuka.

In general character and in elevation these soapstones are comparable with those in Suva. If the rocks here are contemporaneous with those of Walu Bay near Suva, then we may form some idea of their age. In the latter case they are not newer than Pliocene, and may be Miocene. For topographic

reasons I am not inclined to believe the Rewa soapstones older than Pleistocene, though it is possible they may be as old as Pliocene. In the absence of further data the correlation of the Rewa soapstones with those of Walu Bay cannot be considered proved.

Nowhere in this area have basal beds of the soapstone series been observed, so that, in the absence of fossils, their stratigraphical relationships are obscure. In the deep creeks just east of the Medrausucu Range, the lowest rocks encountered are jointed andesites, but these are in all probability intrusive into the soapstones.

Summary of Section i.—The greater part of the area is covered by level-bedded "soapstone" containing traces of plant fossils and representing redistributed tuffs. These form an extensive plain, with an average elevation of some 300 feet. In the surface of this plain the rivers occupy cañon-like valleys. At the head of the Rewa Delta the high-level plain is broken into mesas with an altitude of about 100 feet. The delta is very extensive, and this, together with the occurrence of reef-limestone well within the mangrove belt, proves that there has been no notable change in sea-level for a considerable time. No solid rocks of any kind occur *in situ* anywhere in the region except just at the base of the Medrausucu Range.

ii.—*Medrausucu Range.*

I have taken the liberty of referring to this remarkable range of mountains by an abbreviation for the name of its two most prominent peaks, Medrau sucu basaga. The range is a most striking feature from all points of view. Its eastern face, as seen from the Rewa Plateau, is almost precipitous throughout its entire extent. It is strikingly linear in character, extending for many miles in a N.N.W.-S.S.E. direction. It stretches from the south coast a little west of Suva, to Nacau, a mountain just north of Naivucini, a town at the junction of the Wainimala and Wailase Rivers. At its southern end it is not sharply defined from a number of other mountain ridges,

which cross it more or less at right angles; but throughout the rest of its extent it presents a bold scarp to the east. On my former expedition I did not obtain a good view of this range, and my information led me to believe that the country lying to the west consisted of a high plateau; but, as shown below, this idea is incorrect. Running, as it does, almost meridionally, it cuts directly across the courses of a number of important east and west branches of the Rewa River, chief among which are the Waimanu, Waidina, and Wainivalau, in order from south to north. These emerge from the range through a magnificent series of water-gaps, which are well seen on a clear day from the high-level soapstone hills about Nausori. The chief peaks in the range are Namaku and Wainiwaqa, respectively south and north of the Waidina, Medrau sucu basaga (the Fijian equivalent for "The Paps," by which name this pair of hills is known to the British residents), Kororaqiqi,* Ucikavukavu† and Namolaca, respectively south and north of the Wainivalau, Nariko and Nacau south and north of the Wailase. Nabukelevu, the "Great Yam Mound,"(spelt Buki Levu before) forms a narrow spur extending for two or three miles to the east of the main range.

The true structure of the range, suggested by these water-gaps, is not seen to advantage until viewed from the summit of one of the mountains twelve or fifteen miles to the west. From a point such as Uvuuvunidavui, the range is seen to be simply a wall of rock some 2000 feet in height, and not more than three or four miles in thickness at the base. Lying to the west of its central and northern sections is an extensive plain which will be described in detail later. On close examination the range is found to be built almost entirely of very coarse andesitic agglomerate. The boulders in it are generally of hypersthene andesite, with a base varying from glassy to pilotaxitic.‡ Sometimes hypersthene

* Spelt Kororagigi in my former paper.
† Spelt Kavukavu in my former paper.
‡ Former paper, *loc. cit.* pp.520-525.

fails, and pseudomorphs of magnetite and augite after hornblende appear. Massive products of eruption are quite subordinate to fragmental ones, but numerous dykes and sheets or sills occur. One of the former, Devo,* has given rise to an imposing piece of scenery. In all instances these rocks are perfectly fresh, and have not suffered at all from orogenic processes.

The contrast in form and structure between this range and the Rewa Plateau, immediately to the eastward, is very striking. Soft soapstones run right up to the base of the range, but, at a very short distance within the gorge of the Wainivalau, the agglomerates rest upon granites and jointed rocks. The actual junction-line is obscured. The importance of this structure is discussed later (p.448).

The forms of the peaks of the range are very suggestive of a line of volcanic necks partially denuded.† Nacau, at the northern end of the range, has very strikingly the appearance of a crater rising 1230 feet from the level of the plain to the eastward. Its shape is crateriform, the highest point of the rim lying to the west. The northern portion of the rim, for about a quarter of its circumference, is broken down; and the central portion is occupied by a deep crateral hollow. The southern face exhibits a steep cliff formed by a subsidence of the outer crater-slopes on that side. The northern end of Nariko, facing it across the valley of the Wailase, exhibits a similar cliff; and the ridge joining the two and rising to a level of about 600 feet above the plain probably represents a sunken block.

The cliffs and eastern side of the ridge consist of andesite agglomerate, but the western side of the ridge is of diorite porphyry. The latter rock extends for some distance westward along the valley of the Waiqa River. It will be discussed in the description of that area.

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* Former paper, p.467, plate xxiii., fig.4.

† The high range of hills in the background in the view of Nabukelevu (former paper, plate xxiv., fig.5) has no existence either in fact or upon my negative; it is a creation of the process engraver. The hills behind Nabukelevu were hidden in mist when the photograph was taken.

The water-gaps mentioned above are not the only ones developed in the range. Between Ucikavukavu and Nariko there is another well marked one. It is not, however, occupied by a considerable stream. Close to Serea there enters the Wainimala Valley, a very considerable tributary valley whose bed is occupied by a long lagoon known as the Waieliu or "Former River." This heads towards the gap above-mentioned, and I have no doubt that we are dealing here with an instance of river-capture occurring within historic time. The "pirate" was certainly one of the headwater streams of the Wainivalau, possibly the Waisomo. That this is the case is rendered likely by the large volume of the Wainivalau in proportion to the size of its gorge, as compared with other rivers.

In addition to the main rivers crossing the line of this range, there are numerous smaller streams rising in it which have cut more or less deep notches, such as the Waibowa, rising just to the south of Nabukelevu, Waicevu north of the Wainivalau, Wainimase south of Serea, and several other still smaller creeks.

In the bed of the Waibowa pebbles of granite occur, but in the other minor streams crossed no such granitic material was observed. Pebbles of jointed and saussuritized trachyte, exactly similar to that described later, occur, thus showing that fairly ancient rocks occur within the reach of the east-flowing creeks.

The very great geological importance of this range of mountains will appear later.

Summary of Section ii.—The Medrausucu Range is a remarkable, linear, wall-like range of volcanic mountains stretching N.N.W.-S.S.E. a little to the west of the meridian of Suva. It is crossed by numerous large rivers which have cut great water-gaps in it, and are certainly antecedent streams. There is at least one important "air-gap," and it is highly probable that the river-capture originating this feature took place within historic time. The smaller streams are busily engaged notching the divide. All the topography suggests extreme youth. All the larger, and some of the smaller, streams have reached the

foundation of ancient rocks, in part plutonic, lying below the volcanic material which builds the bulk of the range.

iii.—*Upper Waidina and Waimanu Rivers.*

A journey up the Waidina Valley has already been described,* and very little need be added here. The Great Dyke of Devo (Plate xxiii., fig.4 of my former paper) bears nearly north and south,† and therefore about parallel to the general trend of the Medrausucu Range, on whose western flanks it occurs. It has a distinct underlie to the west.

The general direction of the Waidina Valley is about E.N.E. and W.S.W., that is at right angles to the line of weakness suggested by the trend of the Medrausucu Range. The valley is bounded on the south by a range of hills which have the appearance of a line of denuded volcanoes. It is a very common feature in orogenic processes that lines of weakness develop in the form of a nearly rectangular network; the case under discussion seems to conform to this general law. Another line of hills, in approximate parallelism with the river-valley, occurs on its northern side, in its upper course.

I stated in my former description of the Waidina Valley that the hot spring at Naseuvou rises through solid quartz diorite.‡ This statement has to be corrected. The rock is really jointed andesite, the mistake having been caused by a transposition of specimens.

A small tributary, the Waimanu, enters the main stream on its left bank, just above the town of Nasirotu, and brings down abundant large boulders of quartz diorite, which rock must, therefore, occur *in situ* at no great distance to the north.

I ascertained that the Wainavadu, in which abundant and very large boulders of quartz diorite occur, rises beyond the north-

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* Former paper, p.465.

† Compass bearings in the volcanic parts of the island are often quite unreliable on account of the extraordinary local deviations.

‡ Former paper, p.468.

eastern end of Korobasabasaga at a place called Mataicicia. It thus drains part of the area to the south-west of the Wainivalau Valley, and proves a southward and westward extension of the crystalline rocks met with *in situ* in the latter stream. Judging from the size and abrasion of the boulders, I judge that the granitic rocks occur *in situ* some ten or fifteen miles (by river) north of Delai Lasakau on the Waidina.

There is little to add with regard to the upper portion of the Waidina Valley with the exception of some rather striking topographic details. There is a decided suggestion in places of block-mountain formation; the crests of the blocks have a uniform gentle slope of about 10° in a southerly direction. Fairly considerable streams continue to within a mile or thereabouts of the water-parting between the Waidina and Wainikoroiluva.* They then bend north and south, and so flow parallel to the divide. The latter is itself parallel to the line of weakness manifested in the Medrausucu Range, and, like it, is a linear range of andesitic agglomerates. The most striking feature is, however, the nature of the pass. This has a level floor, about two miles wide, bounded north and south by the towering cliff-faces of Nairibiribi and Natabuwaitui. These answer in every respect to the cliffs bounding the gorges in the Medrausucu Range, through which issue the main streams flowing eastward. The resemblance is so striking that there can be little doubt, I think, that these cliffs mark a comparatively recent water-gap, and indicate a very profound disturbance of the drainage-systems of this part of the island in late geological time.

An examination of the map (Plate xii.) will show that the trend of the Main Navua Valley is markedly collinear with that of the Waidina River. Not only is it collinear, but it is very nearly concurrent. The only break in continuity is at the gap described above, and the water-parting here is not more than about two or three miles wide. The last of the Waidina water crossed on the track is 180 feet below the summit of the pass,

* Called in error the Navua River in my former paper.

while the bed of the Wainikoroiluva is 270 feet below the same point.

I have very little doubt that, originally, the Waidina and the Navua formed one stream. This may have risen somewhere near the present town of Waivaka, and flowed W.S.W. to the sea; or it may have risen near the source of the present Navua, and flowed E.N.E. to join the ancestor of the Rewa. Of the alternatives, the latter is the more probable. The disturbance in stream-arrangement was almost certainly due to heavy faulting along the line of the Medrausucu Range, and along the course of the Wainikoroiluva and lower Navua, leaving the intervening area as a "horst."

No detailed examination was made of the Waimanu Valley. The river has a remarkably uniform general direction a little north of east, parallel to the Navua-Waidina line just referred to and at right angles to the fault-lines which determine the "horst." Like the Wainivalau and Waidina, it has the character of an antecedent stream, crossing the Medrausucu Range (here rather indefinite) by means of a picturesque water-gap. This gap is a very conspicuous feature when viewed from Uvuuvunidavui. I crossed the stream at a point between Vesari and Nabukaluka, and there noted the important fact that granites form a large part of the gravels. From the small size and complete rounding of the pebbles, we see that the outcrops of granite *in situ* must, probably, be near the head of the stream. This brings the granite area considerably further south than it has ever been observed before. I was informed by natives that it is possible to canoe upstream for some distance from its confluence with the Rewa, but then its course becomes broken up by impassable rapids. These continue for some distance above the point where I crossed it, but then the valley widens out again and the river becomes navigable. This agrees with all the other topographic evidences which point to a very recent origin of the Medrausucu Range.

S u m m a r y o f S e c t i o n iii.—The Waidina and Waimanu Valleys are about parallel to one another, and at right angles

to the Medrausucu Range. This suggests that they occupy lines of weakness (possibly faults) at right angles to the dominant topographic line of weakness expressed by the said range. There is strong evidence for considering both streams as antecedent to the range, and for supposing that the Navua River was formerly continuous with the Waidina. The breaking of connection took place through a heavy fault along the line at present occupied by part of the Wainikoroiluva, leaving a "horst" between that stream and the Medrausucu Range. Most of the evidence for these movements is topographic in character, but is none the less extremely suggestive. The changes must have been very recent. Granite areas are proved to exist as a basement under the Korobasabasaga, and further south at the head waters of the Waimanu.

iv.—*Wainivalau Valley.*

I made a journey from Nabukaluka on the Waidina to Narokorokoyawa, our headquarters, along the valley of the Wainivalau. A prospector, Mr. Harding, traversed part of this region, but I was informed that no white man has previously been right across it. Owing to the dangerous nature of the numerous river-crossings (fords they cannot be called) I was compelled to pack up my field book and instruments, and allow a native to carry them. My notes on this portion of the island were therefore written up from memory three days after traversing it.

From the gorge to Nadakuni, the stream hugs the eastern base of the Medrausucu Range; thence it turns eastwards and enters the Waidina just below Nabukaluka. Its bed is not so wide as that of the Waidina, but I believe its volume is nearly as great, a fact already commented on in connection with its probable piracy of the head waters of the Waieliu. It enters the main stream with a very swift current, and at quite a noticeable grade; and as is usual under such circumstances, the bed of the Waidina for some miles above and below the junction, is very much choked with coarse alluvial deposits. About a mile above Nabukaluka, convex curves of the two streams approach within an eighth of a mile of one another. As the divide is of

soft soapstone, a junction at this point is, geologically speaking, imminent.

The gorge by which the Wainivalau issues from the mountains is very remarkable, the cliffs rising perpendicularly on both sides almost from the water's edge, for hundreds of feet. Nowhere east of the Medrausucu Range have I found granite or slaty rock *in situ*, but immediately the gorge is entered highly jointed rocks are encountered, and just to the west of the range granite occurs, *in situ, at a level higher than that of the plateau immediately to the eastward, and much higher than the beds of the streams which have dissected that plateau.* From this point westwards, the surface of the granitic and slaty rocks is more or less uniform right away to the valley of the Sigatoka. I hold that the existence of a heavy fault along the line of the Medrausucu Range is thus rendered extremely probable, if not absolutely proved; and that the volcanic products of the range have been extruded along this fault-plane. We thus add geological evidence to the topographical evidence for an important fault here.

West of the range is an extensive and well-watered plain, of whose existence few people seem to be aware. For long distances the country is practically level, and no outcrops of rock are met with. Account being taken of the fact that the Wainivalau has had to cut a gorge through the Medrausucu Range, I think it very probable that part, at all events, of this plain has been the site of a lake. No definite evidence can, however, be brought forward. Observation and native information show that, even now, the area is subject to frequent inundation, so that it temporarily takes on a lacustrine habit.

At its western edge this plain rises towards the water-parting between the Wainivalau and Wainimala Rivers, and we pass off soft soil on to solid, much-jointed granite. The stream has entrenched itself deeply in the surface of this rock. The granite is overlain by the lavas and agglomerates of the Uvuuvunidavui Range, which is andesitic in character. The plain is bounded on the south by a ridge of no great elevation, separating it from the Waidina Valley. The granites must have a very

considerable south-easterly extension as the Wainivobo brings down abundant large granite boulders, and, as already stated, the Waibowa, on the eastern side of the range, has granitic gravels.

The range which bounds it to the north, and of which the Korobalavu is the chief point, is considerably higher than that to the south. The gravels of the Waisomo prove that the granites extend in this direction too.

Rising from the south-western corner of the plain is the awe-inspiring mass of Korobasabasaga, with its five towering summits (Plate xiii., fig. 1). A more magnificent piece of scenery is beyond the limits of imagination. It rises abruptly, and in places, sheer to a height of nearly 4,000 feet above sea-level, and therefore a good deal over 3,000 feet above the plain. In places there are precipices of quite 3,000 feet. The mass is cleft through its middle, apparently from crest to base, by a stupendous fissure, whose origin I do not at present know. The mountain or rather range has a general S.W. and N.E. extension, and is composed, for the most part, of very massive agglomerates of a very handsome hornblende andesite described in my former paper (p.529). An exactly similar rock is exposed in the left bank of the Wainikoroiluva below Laselase. If the scarp forming this bank is, as suggested, a fault-scarp, the hornblende andesite must be older than the faulting, and therefore probably older than the hypersthene andesites of the Medrausucu Range. This is rather important, as the evidence with regard to sequence of eruptions is so meagre.

In the foregoing sections I have suggested that the plain to the west of the Medrausucu Range represents a "horst" of granitic rock, bounded east and west by two great faults trending S.S.E. and W.N.W. The existence of these faults is, I think, fairly proven by geological and topographical evidence alike, and their very recent date is quite probable. It is also suggested that the ranges of hills bounding the Waidina and Waimanu valleys may be directly due to faulting; on this latter point, however, I do not wish to lay any stress. It is quite likely that

the ridges, as such, are the normal result of atmospheric weathering. Whether this is so or not I believe the very markedly regular trend of the Navua, Waidina and Waimanu, together with that of the Waiqa and Wainimala, to be described later, points to a very marked direction of weakness along a W.S.W.-E.N.E. line.

It is also conceivable that the topography of the Wainivalau basin may be explained in a different manner. The stream might have worked in a general S.S.E. direction across an elevated plateau. Striking the resistant rocks which now constitute the Medrausucu Range, its vertical corrasion might have been checked there, and have proceeded so slowly that its higher waters working constantly over their available area, kept it in the condition of a slowly sinking peneplain, the rate of sinking keeping pace with the corrasion of the range. It would thus have the character of a superimposed river.

Such an explanation fails, however, to explain the essential geological features, and it is impossible to understand why the stronger Waidina, perhaps fortified by the Upper Navua, should not have excavated an even more extensive plain.

The evidence then is strongly in favour of heavy faulting, with building up of a very recent volcanic range at the fault-plane.

Summary of Section iv.—Hydrographic evidence points to the Wainivalau having very recently been enlarged at the expense of some of its neighbours. Geological evidence points conclusively to the existence of a heavy fault under the Medrausucu Range, whose existence has been suggested before (p.446) for topographical reasons. Possible evidence is adduced to show that the hornblende andesites of Korobasabasaga are older than the hypersthene andesites of Nabukelevu. A possible alternative to faulting, as an explanation of the topographical features of this part of the island, is discussed and rejected.

v.—*Waiqa Valley.*

Separated from the Rewa Plateau by the northern part of the Medrausucu Range, and from the Wainivalau Valley by the

Korobalavu Range, is a very interesting district drained chiefly by the Waiqa, a fairly important tributary entering the Wainimala north of Nacau. Crossing the saddle from Naivucini on the road leading west to Botenaulu and Narokorokoyawa, the track rises over the tuffs, agglomerates, and lavas of Nacau until an elevation of about 675 feet above the Wainimala is reached, and then drops to the valley of the Waiqa. At the summit of the pass there occur great angular boulders of a very remarkable diorite porphyry. In section it is found that this rock is somewhat quartzose and very rich in hypersthene, so that it shows relationship to the more acid members of the charnockite group. The western slope is over decomposed rocks of a similar character *in situ*. The remarkable nature of the rock was not recognised in the field, and its relationships to its neighbours are therefore obscure and must be left for a future expedition to determine. The level of the Waiqa River is 575 feet below the crest of the ridge. The stream occupies a fairly broad open valley, the most open of any stream of its size which I have seen in the island.

Granite puts in its appearance at a point between Tavua and Nuku; as above explained, the dividing line between this and the charnockite-like rock is not determinate. Some distance west of Tavua the granite is strongly gneissic in character, and associated with this we have a narrow belt of very schistose rock whose relationships are concealed by lack of outcrops.

For some distance west of Nuku the track crosses alluvials, but about two miles west of the town decomposed granite *in situ* is met with. This rises in high hills which form the eastern boundary of the Upper Wainimala Valley. At the crest of the ridge which separates the Waiqa Valley from that of the Waitabu, the road-level is about 1480 feet above the sea; at the highest point of the range it is at least 200 feet higher than this. In the valley of the Waitabu undecomposed granite is met with *in situ*, but some distance to the west the rock is apparently slaty; exposures are, however, very poor.

It will be seen that the main direction of the Waiqa is about W. and E., this course being imposed upon it by ranges of

volcanic material running in that direction. The hills to the south were not visited; those to the north are more basaltic in character than the ranges to the east.

Summary of Section v.—The Waiqa Valley runs east and west for about twelve miles. Considering the size of the stream, it is a very broad and open valley. The rocks exposed are mostly crystalline (granites and schists), but towards the eastern end a remarkable hypersthene rock, with characters linking it to the more acid charnockites, occurs.

vi.—*Navua-Wainikoroiluva Valley.*

The Navua System is analogous to the Rewa System in that both main rivers keep close to the eastern side of their basins, and draw their waters from wide stretches of country to the west. In both cases there are no important affluents coming in from the east, while very large tributaries enter the right hand bank. This statement is true only if we regard the Wainikoroiluva as the main branch of the Navua System, as I believe it is structurally, though it is certainly inferior in volume to the Navua. On no map of Fiji which I had seen, prior to my recent visit, was the largest stream of the system shown correctly. The information with regard to this portion of the country was supplied by Mr. C. A. Holmes, L.S., Government Surveyor, with the kind permission of His Excellency, Sir Everard im Thurn, and is detailed and accurate.

The structure of the Navua System resembles that of the Rewa in another important particular; the streams in their lower courses are intrenched in a dissected plateau, occupying narrow cañons about 300 feet in depth. The general surface of the plateau is strikingly level, more so than that of the Rewa; from high points in the Namosi district it appears as an almost unbroken plain stretching for miles to the westward. The heights which rise above the general level, such as Koqi, Tuvutau, Nabekalevu, etc., are very strongly suggestive of residuals of at least one older peneplain. The eastern limit of the plateau is sharply defined by the western scarp of the range of mountains,

of which Nalumu and Nabui are two* of the most prominent peaks.

Reasons have already been advanced for supposing this scarp to have originated in late geological time through faulting. Additional evidence of the same fact is not wanting. Almost as soon as the hill country is entered, in the journey up the Wainikoroiluva, that is, below Naqarawai, ancient-looking tuffs are encountered, and a few miles further on quartz diorites *in situ*. The "soapstones" to the west of the range are exactly similar to those of the Rewa Plateau, and, like them, are on the whole horizontally bedded. Close to the range the dips depart from the horizontal. Below Laselase the rocks (andesites) in the bed of the Wainikoroiluva are strongly jointed, indicating powerful earth-movement, and the axis of these joints is S.S.E.-N.N.W.

The upper portion of the Wainikoroiluva is the only part which I have examined in detail, and this has already been described.† Further examination, on my second expedition, confirms my first impressions as to the comparatively great antiquity of the jointed rocks below Naqarawai. It appears quite certain that there is strong nonconformity between these rocks and the level-bedded soapstones which overlie them. Unfortunately no new section was discovered which throws any important light on the all important question of the relation between the jointed rocks and the quartz diorite immediately to the north.

A considerable extension of the granitic and slaty rocks to the westward is proved by the discovery of well-worn pebbles of such rocks in the Wainimokuta, a large stream entering the Waini-

* The Admiralty chart shows only one very high peak here, and my endeavours to fit in the results of my own magnetic bearings lead me to suspect that Nalumu and Nabui are possibly the names of opposite slopes of the same mountain. The Fijians are very poor geographers, with very little conception of direction and distance, and get hopelessly "bushed" when taken out of their own districts.

† Former paper, p.472.

koroiluva just above its junction with the Navua. The main Navua was in flood, so that I could not examine its gravels.

The lower portion of the gorge of the Navua differs essentially from that of the Rewa in being a perfect cañon, with perpendicular walls rising straight out of the water. The reason why it has failed to perform any lateral corrasion, as the Rewa has done, is that the materials it has had to excavate have been much harder. The rocks of the Navua Valley are enormously massive andesitic flows, with some interbedded tuffs, while those of the Rewa are soft soapstones. Until it leaves the tableland and begins to open out at the head of the delta, there are practically no enlargements of its valley; while the Rewa and its tributaries are bordered by rich river-flats and flood-plains which sometimes show two, perhaps three, distinct terraces.

One very striking feature of the cañon of the Navua is the existence of numerous "hanging valleys" in its walls. Even the large tributaries, such as the Wainikoroiluva, enter the main stream by a series of rapids, that is, not absolutely at grade; while the minor affluents often leap from the apparently unbroken bank of verdure of the cañon walls at heights of a couple of hundred feet above the river, making the gorge one of the finest pieces of scenery it has ever been my good fortune to see.

These hanging valleys are, of course, due to the youthfulness of stream-development. Neither trunk nor tributary has yet reached base-level, and the differential erosion of the powerful stream has sunk its bed below the level of its weaker tributaries. Mr. Holmes informs me that similar structures, on an even grander scale, are to be seen higher up the Navua.

S u m m a r y o f S e c t i o n vi.—Additional evidence is adduced in favour of faulting having taken place along the valleys of the Navua and Wainikoroiluva. A comparison is drawn between the structures of the Rewa and Navua Systems. Especially it is pointed out that both systems have linear eastern boundaries, and draw their waters from extensive basins to the west. This strongly suggests block-faulting. Additional granitic areas are shown to exist west of those formerly observed. The

differences in character of the lower Navua and Rewa valleys is explained as due to the difference in hardness of the rocks to be excavated. The incongruity of grade of the Navua and its tributaries, giving rise to hanging valleys, is described.

vii.—*Wainimala Valley.*

The upper Wainimala Valley is one of the most interesting and geologically important districts of the island. Up to its junction with the Waisomo* above Vatuvula, and probably for some distance beyond this, it belongs structurally to the Rewa Plateau. Above its junction with the Wailoa to its head, it shows quite a different structure; its banks in this part afford some of the most valuable sections observed at all.

I chose Narokorokoyawa as my headquarters because it lay in the centre of an area of granitic rocks observed by me on my first expedition. I spent a considerable time in trying to determine the relationships of the rock-masses in this region, with very limited success. The jungles here are very dense, and the country very mountainous; exposures are very few away from the rivers, and the problem cannot be considered finally settled.

The plutonic rocks are of two quite distinct types. The first, represented by the Narokorokoyawa granite,† is a coarse-grained biotite granite, without hornblende, and showing extensive cataclastic structures. The other is represented by the Nadranokula quartz-diorite.‡ It is finer in grain than the granite, has hornblende predominant over biotite, and has suffered less than the granite from shattering, possibly because of its lower quartz content.

Associated with, and separating these plutonic rocks, is a band of slaty rock.|| In my former paper I described a type of this

* This is not the Waisomo referred to under Sections i. and iv., but a larger stream flowing into the Wainimala from the north. There are at least three Waisomos in the Rewa System, the third coming from Navunitorilau, and entering the Wainimala at Nasava.

† Former paper, p.501. ‡ Former paper, p.506.

|| Former paper, p.514.

series, obtained just north of Nasava, as a fine quartzite. It and its associates, extending from Nasava to Narokorokoyawa, are very strongly cleaved, and are, to all appearance macroscopically, slates. My suspicions were aroused on finding that some of the rocks contained porphyritic felspar, and I made an extensive collection in this locality. Microscopic examination of a large number of sections* show that, while many of the rocks vary between actinolitic quartzite and actinolite schist, others are apparently trachytic in structure and composition. Most of these trachytic rocks are strongly silicified and saussuritized, and nearly all show traces of strain. I have etched and stained all the more likely looking ones, but have been unable to detect any nepheline.

It is probable that these rocks represent, not highly altered sediments, as I formerly thought, but highly metamorphosed trachytic lavas and possibly tuffs. While this is so, the possibility of some sediments being present is not excluded.

This discovery very seriously weakens my previous conclusions as to the great age of the slaty rocks, since it shows that the entire absence of fossils is not due to high antiquity and extensive metamorphism. Nevertheless I claim that all the evidences point to a considerable age for these rocks. They are unconformably overlain by andesitic lavas and tuffs, which have none of the signs of chemical and mechanical alteration so conspicuous in them. They are associated with granitic rocks of coarse grain, and have strain-structures analogous to those found in the granites. The extreme complexity of their jointing proves that they have been subjected to several distinct earth-movements in different directions.

Mawson's discovery of jointed Miocene tuffs† in the New Hebrides at least suggests the possibility of a similar age for these rocks. The analogy must not, however, be strained too far; he found no trace of granites, while, in Fiji, these cover enormous areas.

* To be described in a subsequent paper.

† These Proceedings, 1905, Vol.xxx. p.446.

Another band of slaty rock is met with between Botenaulu (called Moira before)* and Waibasaga (called Togicedra before),* and extending some distance northwards. These are even more schistose in appearance than the rocks of the Nasava series; some of them appear in section extremely like some of the felspathic quartzites of the Cambrian rocks of South Australia. Most of them are, however, strongly felspathic and actinolitic, and must probably be classed with the trachytic rocks of Nasava. I attempted to map in the boundaries between these four sets of rocks, but could obtain no definite proof even of their relative ages. They are exposed only at the bottom of the narrow V-shaped river valleys; immediately the hills are mounted one comes upon the level-bedded later volcanic series. In the river-beds and jungle-covered banks I found no sections showing junction-lines between the granites and slaty rocks. The entire absence, even amongst the river-gravels, of quartz porphyries, and the fact that no granitic veins were observed in the field intersecting the slaty rocks, seem to indicate that the granites are older than the slates. On the other hand, there is no definite evidence of trachytic dykes in the granite masses, unless certain small masses near Botenaulu are of such a character.

The general trend of all the members of the older series is about N.N.E.-S.S.W., which also agrees with the direction of dip of the jointed tuffs south of the Udu.† There is no doubt that this area of crystalline and slaty rocks is continuous with those met with in the Wainivalau, Waiqa, and Wailato,‡ and elsewhere. The generally even surface presented by these rocks points to their having formed a peneplain. *This involves an extensive land surface, powerful earth-movements, and enormous denudation during a protracted period of existence above sea-level, in other words, a continental character for the ancient land.* The

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*Moira is the name of the district, and Botenaulu is its chief town. Tokikicedra is the name of the rocks actually photographed (These Proceedings, Vol. xxviii. Pl. xxxi. fig.14) opposite the town of Waibasaga.

† Former paper, p.476.

‡ *Vide infra*, p.469.

surface of the peneplain is everywhere covered with a later unconformable series of more or less level-bedded volcanic products, save where the latter have been dissected away since the last great uplift. In the neighbourhood of Narokorokoyawa the level of the ancient peneplain is only about 300 feet above the river bottom and about 800 feet above sea-level. Southwards at Navunitorilau it rises to over 1,300 feet, and northwards at Rewasau to about 1,100 feet. It must not be forgotten that these and other differences of level are probably due to the tilting accompanying block-faulting.

The Waibasaga, flowing from the west to meet the main stream at the town of the same name, plunges over the edge of the volcanic plateau to the level of the granitic peneplain in three magnificent waterfalls, called Wavou, with a total drop of over 1,600 feet.

In the upper part of the Wainimala Valley, that is above Udu, there seems to be some topographic indication of an older valley-level from 50 to 60 feet above the present stream. There are in places, as near Matainasou, very distinct cut terraces which appear to indicate that the stream cut out a moderately U-shaped valley, and then quite recently suffered uplift which caused increased vertical corrasion in the bottoms of such valleys. This is a point which is worthy of further investigation.

Summary of Section vii.—The plutonic and slaty rocks described in my former paper are described in much more detail. It is shown that there are four distinct belts, with a general N.N.E.-S.S.W. trend; and that these form part of an extensive old peneplain, now covered unconformably by more recent volcanic accumulations. Many of the slaty rocks, formerly believed to be sedimentary, are now shown to be slaty trachytes. No evidence is forthcoming to definitely prove the relative ages of plutonic and slaty rocks; the balance of the negative evidence available leans towards the granites being the older. Certain physiographic peculiarities of the valley cutting are referred to, but no explanation of the very extraordinary course of the Wainimala between Nasava and Naivucini is attempted.

viii.—*Wailoa and Nadarivatu District.*

The Wailoa River (Black River, so called on account of the abundance of magnetite sand and limburgite gravel in its bed) is the principal tributary of the Wainimala River. It rises in the southern slopes of Tomanaivi, the highest point in Fiji, and flows in a general S.S.E. direction, joining the main stream just below the town of Udu.

Nadarivatu is situated immediately on the northern edge of the high plateau which extends here within a few miles of the north coast, and in places actually reaches the coast. It lies at an altitude of about 2600 feet above sea-level.

The whole area included in this section is characterised by a remarkable development of extremely basic limburgitic lava, and associated tuffs and agglomerates. These form practically the universal surface-rocks of the district.

Eastwards they pass into the level-bedded "soapstone" tuffs of the Wainibuka. These soapstones, which are gently dipping in places, extend from about Nubumakita right away to the north-east coast apparently. It is extremely probable that they represent the actual extension of the limburgite series, beyond the eastern limit of its solid lavas.

Towards the south the area is bounded fairly sharply by the Wainimala, which, about Udu, suddenly turns east after flowing north for a long distance. The more or less linear boundary of the basic series, corresponding as it does with this sudden change in direction of a main river-valley, certainly points to some major earth-structure; but evidence as to its exact nature is wanting.

Northwards the area reaches the sea at a point north-east of Nadarivatu. To the north-west of Nadarivatu there is a very sharp drop of 2000 feet to the village of Waikubukubu, whence a coastal plain, some eight or nine miles wide, slopes to the mouth of the Tavua River. This coastal plain was described in my former paper (p.478), and it was there inferred from the crateriform shape of the numerous hills which cover it, and from the evidences of extinct hot spring action, that volcanic activity has only comparatively recently died out in this portion of the island.

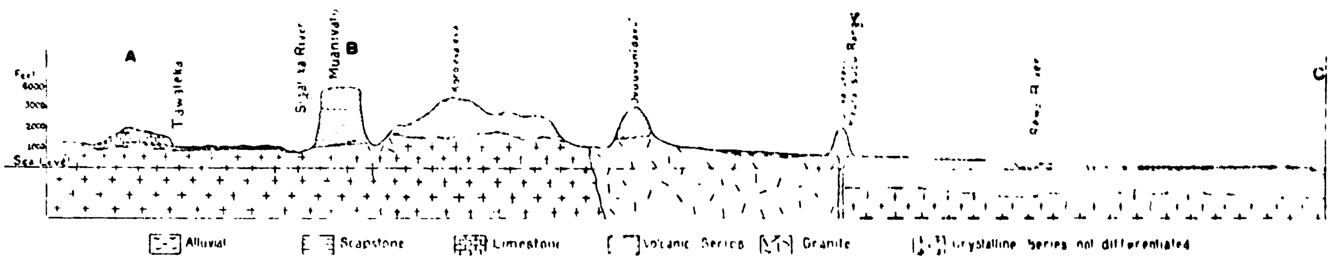

Fig. 2.—Geological Section across part of Viti Levu, Fiji, along the line A B C on the Map (Plate xl.).

This inference is strengthened by the fact that hot springs do occur in the north-west part of the plain, west of the Tavua River. From what I could make out from rambling native descriptions, these springs, of which there are two sets, must be considerably hotter than those in any other part of the main island, though probably not so hot as those of Savusavu Bay in Vanua Levu, described by Guppy.* I understood that the water was at times hot enough to severely scald one. The flow appears to be spasmodic and, the natives stated, sometimes violent.

In my former paper I suggested the possibility of a fault bounding the Nadarivatu scarp.† Most of my correspondents have taken my statement to mean that such a fault had definitely been proved to exist. I did not intend such an impression to be created; even at the time I regarded the existence of such a fault as highly problematical, and further investigations have shown that no such fault exists in this place. I have now no doubt that Dr. Guppy's explanation‡ of this plain as a recently elevated plain, chiefly of marine accumulation, is the correct one.

Westwards, the area extends at least as far as the Sigatoka River at Nadrau. Sections of the columnar andesite exposed there, and formerly described as an augite andesite, show that the rock is much more basic than was supposed, a limburgite in fact, very similar to the Nadarivatu rock but more basic. The strong curvature and divergence of the columns indicates that the cooling surface in contact with the rock was irregular. There are two flows separated by a bed of fine tuff. The lower one rests on a coarser tuff containing beautifully perfect augite crystals, and *recognisable remains of marine organisms.*

The most interesting feature of the area under consideration is the shell-bearing conglomerate at Nasoqo, previously described.§

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* Guppy, H. B., "Observations of a Naturalist in the Pacific," etc., 1903. Vol. i., p.25.

† *loc. cit.*, Plate xxxiv.

‡ Private communication.

§ Former paper, p.477.

I revisited the locality, and searched it as well as very adverse conditions would allow. Although no fossils better than those before obtained were collected, my previous work is confirmed in every particular. It will be shown later (p.468) that the granite floor has been met with, *in situ*, at a point only a little to the south of this, and can lie at only a very slight depth below the Nasoqo conglomerate which is, therefore, in all probability a basal conglomerate. As it lies at an altitude of 790 feet above sea-level, the uplift during Cainozoic time must have been at least that amount.

The level-bedded tuffs associated with the limburgite series reach an elevation of over 4000 feet. From their great uniformity of composition and their persistence, they must certainly be marine, for it does not seem possible to obtain such uniformity and level bedding in a subaërial formation. If this is so, the elevation during Cainozoic time must have reached at least 4000 feet.

If the tuffs are marinæ, then their associated flows must also be submarine, and yet they extend with perfect uniformity over very wide areas. The only very vesicular lavas met with are north of Udu, and north of Nagatagata on the Sigatoka.

Another conglomerate, similar in many respects to that at Nasoqo, occurs below the village of Dubuya south of Nadrau. It does not seem to contain any fossils, and I found no pebbles other than andesitic ones in it. It is, however, related to the older rocks below Waisa.

Summary of Section viii.—The rocks of this district are essentially level-bedded soapstones, with intercalated limburgites. These are all certainly of marine origin, and, since they rise to over 4000 feet above sea-level, point to an uplift of at least that amount in Cainozoic time. A basal conglomerate containing granite pebbles and resting on a floor of granitic rocks (exposed a little distance to the south) is met with at Nasoqo on the Wailoa. In it occur marine shells, including *Conus*. These are too poorly preserved for specific determination, but are certainly Cainozoic. Shells (*Pecten*, etc.) and corals (*Goniophyllum*) also

occur in a tuff below the main limburgite at Nadrau. Another conglomerate occurs south of Nadrau, but does not contain granite pebbles nor fossils. It is, however, probably the base of the limburgite series.

Passing eastwards, the solid rocks disappear, leaving only the tuffaceous members of the series.

The fault at Nadarivatu whose possible existence was suggested in my former paper, does not exist. Hot springs occur near Tavua, bearing out the suggestion that volcanic action has been very recent in this part of the island.

ix.—*Muanivatu District.*

This district lies in the Sigatoka Valley, just about the junction of several large tributaries with the main stream. I have taken the liberty of calling the district after the noble mountain peak, over 4000 feet high, which is its most conspicuous feature.

This area is of very great geological importance, on account of the sections afforded of the older rocks, and the possibility that some of these sections may show the relationship of these rocks to fossiliferous formations. The district is well worthy of a separate expedition. I was prevented from returning to it on account of floods. Among the points of special geological interest may be mentioned the wide area of granite and associated rocks of the Wailato, Waivou, Wainasa valleys; the slaty rocks of Namoli* and the district immediately to the north, the hot springs of Waibasaga, the granite-bearing agglomerates of Nukuilau, the cave-limestones of Tawaleka, the level-bedded soapstone of the higher parts of the district, and the magnificent volcanic mass of Muanivatu itself.

My former traverse indicated that no granitic rocks outcrop in the valley of the main stream of the Sigatoka, though granitic pebbles are abundant, particularly below Waibasaga. At this town a large tributary, the Wailato, comes down from the east. At a point only a mile or so above the junction, the granite is

* Called Nalaba in my former paper.

met with *in situ*. It nowhere rises much above the level of the stream, and is capped by rocks of the later volcanic series. It is associated with strongly jointed andesitic rocks. The Wailato is only one of a series of rivers rising in the neighbourhood of Muanivatu; and in the other streams, at all events in the Waivou at Nakoro, and the Wainasa above and below Naduta, similar granitic rocks occur, with the same relationship to stream-development as that noted above. We have, therefore, a wide extent of these older rocks brought to light in this district, at or about the same level as those in the Wainimala, Wainivalau and Waiqa Valleys, and, like them, retarding the vertical corrasion of the rivers. The two sets of exposures are certainly continuous beneath the overlying volcanic series, so that a great area is indicated for the granitic series.

The slaty rocks of Namoli were inaccessible owing to flood, but the discovery of granite *in situ* so close to the south-east is an argument in favour of the considerable age of the slaty rocks. The hard, green, jointed tuffs* south of Waisa† certainly belong to the same series.

The hot springs at Waibasaga on the Sigatoka, like those of Naseuvou on the Waidina, occur close to what appears to be the edge of the granitic area, or, rather, close to a spot where that area is brought to the surface, possibly by faulting.

At the town of Nukuilau an interesting and important section occurs. Just west of the town is a small creek in whose bed large boulders of granite occur. It is, however, somewhat doubtful whether granite occurs *in situ* in the watershed of this creek. A road-cutting close by shows a series of tuffs containing *large rounded boulders of granite* in abundance, and this may be the immediate source of the boulders in the creek. The granite is relatively more abundant than in the Nasoqo conglomerate, but in the Nukuilau beds fossils do not seem to occur. The section is nevertheless confirmatory of the Nasoqo section as

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* Former paper, p.480.

† Possibly the name of the district and not of the town.

indicating the lapse of an enormous period of time between the injection of the granite and the formation of the tuff.

The cave limestone of Tawaleka is considerably folded, the contortion being connected with that of the tuffs further down the river. The latter were not visited during my second expedition.

A splendid view of a mountain called Nasikawa, east of Natuatuacoko, is obtained from the hills north of Tawaleka. From this distance it appears to have the structure of a mountain composed of dipping beds of varying hardness, dip slopes and scarps being recognisable. The dip is about W.N.W. at 40°.

Most of the higher points in the district are composed of level-bedded soapstone. This is met with unconformably overlying the slaty rock at Namoli, and there attains an altitude of fully 1,500 feet above the river-bed, and about 2,100 feet above sea-level. A similar material occurs unconformably (?) overlying the cave limestone at Tawaleka.

The top 1,000 feet, or thereabouts, of Muanivatu, consist of a mass of columnar pyroxene andesite. It is possible that this may be a sill, but it is more probably a flow. It yields magnificent precipices.

Summary of Section ix.—This district, lying not far from the head of the navigable water of the Sigatoka, was so far removed from my base that I have not yet explored it thoroughly. While in the district, meteorological conditions were extremely unfavourable. I have seen enough, however, to prove that the energies of any future expedition should be concentrated on the solution of the many problems presented by it.

Granitic rocks do not occur in the bed of the main stream, but highly jointed, ancient-looking tuffs and slaty rocks form the bed, from about Waisa at least to Koroilevu. Granites and related rocks are extensively exposed in the group of tributary streams which meet the main river between Namoli and Waibasaga. These are about the same general altitude as the granitic rocks of Narokorokoyawa, and undoubtedly form part of the ancient peneplain referred to under Section vii. of this paper. A granite-bearing

conglomerate occurs at Nukuilau, proving that granites were exposed at the surface at the time when the bottom beds of the tuffaceous series were being deposited. This tuffaceous series reaches a thickness of at least a couple of thousand feet, and is level-bedded and almost certainly marine. It is probable that the cave limestone of Tawaleka is part of this series, though it is by no means impossible that it may be portion of an older series. There are beds of tuff (?) east of Natuatuacoko, dipping W.N.W. at high angles; their relationship to the limestones and granites remains to be discovered. The upper portion of Muanivatu consists of an enormous mass of pyroxene andesite.

x.—*Navosa Plateau.*

This district lies at a very uniform height of 3,000 to 3,500 feet above sea-level. It stretches from the Wainimala on the east, to the Sigatoka on the west. Southwards it is bounded by the deep valleys south of Muanivatu and Korolevaleva. Northwards it runs into the higher portion of the Nadarivatu Plateau, which culminates in Toma na Ivi at 4,555 feet.

Both east and west slopes are extremely steep. As noted above (p. 458), a considerable river plunges over its eastern scarp, and forms the magnificent falls of Wavou, near Waibasaga on the Wainimala. Throughout the greater part of its extent it consists of level-bedded soapstones which, for reasons given above, I consider to be of marine origin. Only in the lower portions of its eastern scarp are solid rocks met with. Here there are pyroxene andesites resting on granite. Its western scarp, forming the left bank of the Sigatoka gorge at Namoli, is composed of soft, greasy, level-bedded "soapstone" almost down to river-level. Only at two points on the surface of the plateau were solid rocks encountered, and these were certainly parts of the Muanivatu mass just described. Almost the whole surface is a hideous morass.* It is drained (!) by

* I strongly advise anyone intending to cross this plateau to do so either from Nadrau to Rewasau, or from Naduta to Nasava, viâ Korolevaleva. These tracks are both bad, but nothing like so bad as the dreadful one from Namoli (or Tavua) on the Sigatoka to Waibasaga on the Wainimala.

a number of streams of fairly considerable volume. Towards its south-west corner these streams flow into the Sigatoka, but throughout the greater part of its extent the drainage is towards the Wainimala. Thus the Sigatoka, along part of its course at all events, like the Navua and Rewa, keeps close to the eastern margin of its watershed. The apparent exceptions to this general rule are almost certainly due to piracy of Wainimala water by branches of the Sigatoka in the Muanivatu area.

The plateau, though rather barren geologically, is an extremely important topographic feature. It has a powerful effect upon climate and rainfall, and on the distribution of the flora of the island. To the east, we have the heavily forested country and bamboo jungles of the Rewa and its tributaries; to the west, the rolling hills of the Sigatoka and Ba, covered with a jungle of reeds about 8 to 10 feet high. The surface of the plateau is densely wooded, but the downward limit of forest trees on the western side is extremely sharply defined, and forms a most remarkable "timber line." It has also had a powerful influence on the migration of the Fijian tribes; the people on opposite sides of the range belong to quite distinct types.

Summary of Section x.—The Navosa Plateau separates the Wainimala and Sigatoka Valleys, and rises to an average height of over 3,000 feet above sea-level. On both east and west it is bounded by steep escarpments. It is almost entirely composed of level-bedded soapstones, which on the eastern side overlie, and on the western underlie, andesitic rocks. Below the falls of Wavou on the east, the andesites overlie the granitic rocks of the Narokorokoyawa series. It is an extremely important feature in determining the distribution of climate, rainfall, vegetation, and races of men.

xi.—*Nadrau-Rewasau Section.*

This belongs structurally to the Navosa Plateau, but I have separated it to call special attention to two very important occurrences. One is the section at Nadrau on the Sigatoka, the other that at Rewasau, in the Wailoa Valley.

The former has already been described.

North-west of Rewasau the surface of the plateau consists of a veritable "clinker field" of very basic lava. This rests on a series of several hundred feet of level-bedded soapstones. Then comes a thick and very massive *agglomerate or conglomerate bed resting directly upon an irregular surface of granite.* This is the only place, so far as I know, where the actual junction-line can be seen between the conglomerates at the base of the soapstone series and the pavement rocks. This point is within two or three miles of Nasoqo, where the granite-bearing fossiliferous conglomerate occurs, but at the latter place the pavement rocks are not exposed. The Bualevu conglomerate of the Sigatoka underlies the fossiliferous tuffs and basic lavas of Nadrau in almost identically the same way as the similar formation under consideration. At Bualevu the conglomerates are not far removed from the jointed tuffs of Waisa, which may have formed their surface of accumulation, but no junction-line is seen.

Between Rewasau and Nadrau the greater part of the track crosses level-bedded soapstones. In several places, however, there are exposures of considerable extent of andesitic rock. There are also patches of much-jointed rock which may represent inliers of the older series.

S u m m a r y o f S e c t i o n x i.—The chief point of interest in this district is the highly interesting and important section at Rewasau, showing a coarse conglomerate resting on the denuded surface of a mass of granite. This is certainly the same formation as has been met with at Nasoqo and is in all probability continuous with a similar conglomerate at Bualevu on the Sigatoka. Both the latter occurrences have Tertiary fossils associated with them.

General Summary of Results.

The greater portion of the island of Viti Levu is covered by a thick series of level-bedded "soapstones," which I believe to be marine redistributed tuffs. In places, as in the Nadarivatu District, thick flows of limburgitic lava are interbedded with the

soapstone. Elsewhere, as at Suva and at Tawaleka, we have interbedded fossiliferous limestones, certainly of Tertiary age. These rocks form what I have somewhat loosely termed the "Newer Series." They lie unconformably upon a much older series of rocks, amongst which granitoid rocks predominate. With these are associated extensive areas of rocks with highly perfect and very complex slaty cleavage developed in them. These were formerly believed to be altered sediments, but later investigations have proved that in many, if not most, cases they are highly metamorphosed volcanic materials, in part trachytic. That they are much older than the newer series is proved by the very marked lithological differences, by their universally inferior position, and by the occurrence of pebbles of granite and other rocks in massive beds of conglomerate at Nasoqo on the Wailoa, Rewasau on the Wailoa, and Nukuilau on the Sigatoka. All these places are at, or very near, the junction of the "Newer Series" with the older series. At Bualevu on the Upper Sigatoka there is another conglomerate on probably the same geological horizon, but no granites have been found in it. At Nosoqo, and at Nadrau (near Bualevu) fossils have been found which show that the beds in question belong to some part of the Tertiary era, though their preservation is not good enough for specific determination. We have, nevertheless, the very important conclusion that basal conglomerates of a great Tertiary series rest unconformably upon, and contain pebbles of, an enormously older series made up of granitoid and slaty rocks.

So widespread is the newer series that it is only where extensive denudation has removed it locally, that the older series is exposed to view. We therefore meet with the older rocks chiefly in the bottoms of the narrow, young river-valleys. In such positions they have been met with *in situ* in the Wainivalau, Wainimala, Wailoa, Sigatoka, Wailato (and neighbouring streams) and Wainikoroiluva Rivers. Their presence is inferred from river-gravels in the Waimanu, close to the Waidina, and in some of the north-west branches of the Navua Rivers. In one place only, so far as I know, do they occur extensively forming the

main water-partings of the island, namely, at Navunitorilau, between the heads of the Wainikoroiluva and Wainimala Rivers. Their existence as a basement has been proved over an area of at least 35 miles by 30 miles. It is inferred that their surface was, prior to Tertiary time, reduced to the condition of a peneplain.

The most recent rocks (excluding the present-day river-alluvials and the coral-reefs) appear to be a series of andesitic volcanics varying from pyroxene andesite to hornblende andesites. It is likely that, of the two, those of hornblendic facies are the older. These andesitic rocks form lofty mountain masses, and yield magnificent scenic effects. They have, in part at all events, been extruded along major fault-planes, which have had a dominant influence on the structural features, and even on the very existence of the island of Viti Levu and of the Fiji Group as a whole.

Faulting.—One very important line of faulting is shown to exist, in a general N.N.W.-S.S.E. direction, along the course of the Medrausucu Range; a parallel line is inferred, with great probability, to exist along part of the courses of the Wainikoroiluva and Navua Valleys. The country between these two faults is of the nature of a "horst."

A second axis of faulting about at right angles to the first is suggested, but the evidence for its existence, resting as it does solely on topographical evidence, is not so convincing as that for the other axis.

Uplifts.—The basal beds of the newer series reach an altitude of 1350 feet above sea-level near Nadrau; the granitic rocks attain about the same level at Navunitorilau. The topmost beds of the level-bedded soapstones reach well over 4000 feet, and probably the rocks (limburgites and tuffs) forming the highest summit in the island (Toma na Ivi, 4555 feet) are members of the same series. The soapstones are certainly marine beds, and we thus have evidence of a positive movement of the land, during Cainozoic time, amounting to well over 4000 feet. Further investigation is necessary to completely trace the stages of this

elevation. It is certain that it was a differential movement. The levels of the highest beds of soapstone and of the basal conglomerates of the newer series agree in pointing to a general tilt towards the south-east.

River-development points to the same conclusion, since the three great river-systems of the Rewa, the Navua, and the Sigatoka have markedly asymmetrical drainage-trees, drawing their waters almost entirely from the northern and western portions of their basins. The exceptions to this rule, which are most marked in the case of the Sigatoka, are believed to be explicable as a result of river-piracy on a large scale. The Sigatoka has probably been robbed by the Ba, but has enriched itself at the expense of the Wainimala and probably of the Navua.

It is possible that the original tilt was towards the E.N.E., but more probably the marked trend of several of the chief streams in that direction has been determined as a result of the faulting explained above. It will be seen that the rivers have a marked tendency to a rectangular arrangement along general E.N.E.-W.S.W., and N.N.W.-S.S.E. lines. It is believed that this tendency has been imposed upon them by block-faulting of the land. The suggestion is made that the upper Navua and Waidina Valleys were at one time continuous, but have been cut off by the fault along the Nalumbu-Nabui Range.

The rivers are all in a condition of youthfulness. They are for the most part still engaged in sinking deep narrow cañons in the surfaces of otherwise level plateaux. In the case of the Navua River the drainage-system is so immature that its tributaries do not meet it at grade, and the smaller ones form veritable hanging valleys. This immaturity is partly due to the hardness of the rocks through which the beds have to be sunk, as compared with those in the Rewa and Sigatoka Valleys. Both the latter streams have progressed considerably towards maturity, as the "falls-line" on the Rewa has receded a very long way, and the stream has, within the present cycle, built a large delta.

There is abundant evidence, particularly in the Rewa Valley, that the earth-movements have been chiefly positive, and that they are probably still in operation. There are remains of older delta-deposits about the head of the present delta, and about 200 feet above its level. This intermittent, but probably not oscillatory, uplift may account for the entire absence of lakes in such a youthful topography. The only possible evidence of lakes is in connection with the Wainivalau Valley. This stream was probably temporarily dammed by the elevation of the Medrausucu Range.

Most, or all, of the streams flowing across the trend of this range are excellent examples of "antecedent rivers." In the case of the Waieliu (Former River) there seems to be a suggestion of river-capture having taken place on a large scale within historic time.

The rivers of the north-west have not been critically examined, but their distribution shows that there is a very fine field there for physiographic research.

Conclusion.

The accumulation of evidence, both of a geological and of a geographical nature, while it points to certain mistakes in detail in my former work, on the whole strongly bears out the conclusions arrived at in the paper presented to this Society about four years ago.

The great extension of granitic and slaty rocks, their base-levelling to form a peneplain, their relatively great age, as proved by the occurrence above them of basal conglomerates of Tertiary age, and the occurrence of very heavy systematic faulting, all lead towards the conclusion that Viti Levu, and therefore probably the whole of Fiji, has been a land-area for enormous periods of time, even reckoned geologically. It has had sufficient magnitude and durability to permit of earth-movements competent to produce schists: it has existed so long as a land-surface that large rivers have had time to reduce it to base-level. These facts constitute in my mind the essentials of a continental area. Its relationships to the surrounding continental masses have been

fully discussed in my former paper, and the mechanism of separation, namely faulting, was there suggested. In this paper it is shown that some faulting, at all events, has occurred.

I am therefore compelled to respectfully differ from Dr. Guppy* in his general conclusions as to the origin of Vanua Levu. He believes that the second island of the group is essentially an oceanic island, built up from great ocean depths, and that it has never formed part of a great continental mass. Its axis is parallel to the second line of faulting I have suggested for Viti Levu, and the whole of the structure lines of the group strongly suggest that the archipelago is essentially a unit built upon the axes which I have postulated for the main island.

The absence of granitic or slaty rocks on Vanua Levu may possibly be explained by the fact that its rivers, not being so powerful as those of Viti Levu (I do not speak here from personal experience) have not as yet succeeded in reaching and laying bare the basement rocks.

With his reading of the later portions of the geographical history, I am in agreement, particularly as regards the general upward movement of the land. No student of Island geology can fail to be indebted to his painstaking labours for many valuable suggestions, even if he cannot share with him all his conclusions.

In conclusion I beg to again point out that a most fascinating field for study lies almost at our doors. The work is of interest and importance to the biogeographer as much as to the geologist, and I sincerely hope that Australian men of science will not rest till the secrets of this wonderful land have been completely laid bare.

POSTSCRIPT *(added 16th August, 1907).*—I have lately received from the Rev. — Lelean, of Nailaga, a suite of specimens illustrating the gravels of the Ba River. They contain no trace of granite rocks, so that the older series cannot outcrop extensively in the area drained by that river.

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* "Observations of a Naturalist in the Pacific." London.

EXPLANATION OF PLATES XI.-XV.

Plate xi.

Geological Sketch Map of Viti Levu, Fiji.

Plate xii.

Map of Viti Levu, Fiji.

[*Note.*—The gaps in the last two syllables of the name WAINIKOROILUVA (just above the name NABUI) represent the missing letters L and V.]

Plate xiii.

Fig. 1.—Korobasabasaga from the east. Nearly 4,000 feet above sea-level. Native name means "the mountain with the much divided summit." It represents the denuded remnant of a line of volcanic cones along a N.E. and S.W. axis. The summits consist of solid necks of hornblende-andesite agglomerate, and were probably amongst the earlier Cainozoic volcanoes.

Fig. 2.—Voma, a volcanic peak at the head of the Waidina River. It is composed essentially of hypersthene-andesite agglomerate, and is probably amongst the latest of the Fijian volcanoes.

Plate xiv.

Fig. 1.—Nabui, another hypersthene-andesite peak on the Wainikoroiluva River. It probably belongs to the same suite of eruptions as Voma, and is later than Korobasabasaga, which lies a little to the north-east. The precipitous fall in the picture is about 2,000 feet high, and may be the direct result of faulting.

Fig. 2.—Upper Waidina Valley, showing that the stream has in places passed the period of extreme youth, though it is still quite young. The forms of the mountains in the background strongly suggest block-faulting.

Plate xv.

Figs. 1-2.—Sections of upraised (Tertiary) coral reef exposed in road-cutting behind the hospital, Walu Bay, Suva. The "reef channels," characteristic of present-day reefs, are filled in with "soapstone," which also covers the limestone. Photographs by C. A. Holmes, Esq., Suva.

WEDNESDAY, JULY 31st, 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, June 31st, 1907.

Mr. A. H. Lucas, M.A., B.Sc., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 22 Vols., 100 Parts or Nos., 21 Bulletins, 3 Report, 38 Pamphlets, and 2 Portraits received from 69 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Cheel exhibited a specimen of *Coprinus comatus* Fries, which he had found to be common on grass lawns in the Botanic Gardens, Sydney, and in other localities in the Port Jackson district, in June and July. It is an edible fungus, in great request on the Continent and in America. In decay, it melts into an inky black fluid. It should be collected for edible purposes whilst the gills are white or pink. The species has not previously been recorded from New South Wales, so far as the exhibitor could ascertain.

Mr. Cheel exhibited examples of the curious Horse-hair Fungus, first recorded by Baron von Mueller as *Marasmius equi-crinis* F.v.M. [Frag. xi. 1880, p.90 (not 80 as indexed)], by some authors quoted as *Marasmius crinis-equi* Muell. From a superficial resemblance to the lichen *Alectoria Fremontii* Tuck., it had been erroneously regarded as representing an allied species and described as *A. australiensis* Knight. The specimens exhibited were from Coomera, N.S.W. (Rev. F. R. M. Wilson), but other examples had been examined from the Upper Richmond River, N.S.W. (Mr. Fred. Turner, F.L.S.). The attention of possible collectors was called to the fact that the only perfect specimens known seem to be those in the Berkeley Herbarium, Kew Gardens.

THE MOLLUSCA OF MAST HEAD REEF, CAPRICORN GROUP, QUEENSLAND.

Part II.

By C. Hedley, F.L.S.

(Plates xvi-xxi.)

(Continued from Vol. xxxi., p.479.)

A moderate estimate of the total molluscan fauna of the Capricorn Group is a thousand species. It could not be adequately represented by such a collection as that on which this paper is written, procured within a week in six miles' radius of one spot.. The leisure hours of the past two years have not sufficed to exhaust our gatherings. Numerous species, especially among the difficult groups of Triphoridæ and Pyramidellidæ are laid aside. So that in addition to the 447 species now enumerated from Mast Head, more than 100 are left unstudied. My catalogue includes 55 new to science, 123 new to Australia, and 202 new to Queensland. Many hitherto not observed north of Sydney or south of Torres Strait have their respective boundaries much enlarged.

Almost exactly the same number of species are reported by Messrs. Melvill and Standen from a collection formed within 100 miles radius of Thursday Island by Prof. A. C. Haddon. The two lists have only a small proportion in common. But this discrepancy indicates less a difference in fauna than a contrast in methods of collecting. The conspicuous shells from the beaches predominate in Prof. Haddon's collection, while the Mast Head list includes more minute species from deeper water.

There are three other important collections described from the coast of Queensland. The bivalves from the 'Chevert' Expedition

were never published. But of that collection 673 species were enumerated by Mr. J. Brazier.* The 'Challenger' Expedition dredged 230 shells in Queensland waters, while the 'Alert' obtained 181.

(Addenda to Part i.)

The chiton *Acanthopleura spiniger* Sowerby, was abundant amongst the oysters on the nigger-heads, but was omitted from the preceding list.

In the previous Part a conspicuous bivalve from Mast Head was catalogued (p.466) as *Pitaria inflata* Sowerby. As the result of further study, I now consider that this is the species pourtrayed on Pl.152 of Martyn's 'Universal Conchologist.' The "explanatory table" of that work cites two species of mussel for this Plate 152, but these names evidently refer to the two mussels of the preceding Plate 151. So far as Martyn is concerned, our shell is therefore nameless. My determination was based less on Sowerby's original account† than on Reeve's figure,‡ the locality, "Port Curtis," in the latter having weight.

I referred a specimen to my friend, Dr. W. H. Dall, who with his usual kindness gave me the benefit of his judgment and knowledge, as follows:—"It is a *Pitaria* according to my synopsis, and very close to *P. albida* Gmelin, from the West Indies, but more globose and shorter. I do not find it in Sowerby or Roemer, and I think it is not Sowerby's *inflata*. Conrad's *Cytherea prora*, Journ. Acad. Nat. Sci. Philad. vii. 1837, p.253, pl.xix., fig.18, agrees well, both figure and description. He says it 'inhabits the Pacific, probably towards the coast of New Holland.' We have no specimen of this. The shell Reeve called *prora* from the Gulf of California is *C. pollicaris* Carpenter, quite a different shell. It therefore seems likely that your shell may be *prora* Conrad, but I cannot say positively, having no specimens."

* For illustrations and critical notes on this series, see Records Austr. Mus. iv. 1901, pp. 121-130, pls.xvi.-xvii.

† Sowerby, Thes. Conch. ii. 1853, p.637, Pl. cxxxiii., f.127-8.

‡ Reeve, Conch. Icon. xiv. 1863, Dione, Pl. ix., f.3.

Here follows a list of the

Gastropoda.

* New to Australia.
† New to Queensland.

Schismope atkinsoni Ten. Woods.
Scutus unguis Linné.
* *Subemarginula cumingii* Sowerby.
* *tricarinata* Born.
† *Emarginula dilecta* A. Adams.
* *convexa* Hedley
Fissuridea jukesii Reeve.
† *proxima* Sowerby.
quadriradiata Reeve.
* *galeata* Helbling.
* *Macroschisma madreporaria* Hedley.
† *Zeidora lodderæ* Tate & May.
Rimula exquisita A. Adams.
Haliotis varia Linné.
asinina Linné.
* *Microtis tuberculata* A. Adams.
* *Stomatella concinna* Gould.
† *biporcata* A. Adams.
sulcifera Lamarck.
* *Stomatia phymotis* Helbling.
† *Gena varia* A. Adams.
* *ungula* Hedley.
Trochus obeliscus Gmelin.
fenestratus Gmelin.
maculatus Linné.
* *calcaratus* Souverbie.
* *Clanculus granti* Hedley.
* *stigmatarius* A. Adams.
atropurpureus Gould.
* *Gibbula maccullochi* Hedley.
Monilea pudibunda Fischer.

Monilea lifuana Fischer.
* *tropicalis* Hedley.
Calliostoma similare Reeve.
monile Reeve.
* *trepidum* Hedley.
Turcica maculata Brazier.
* *Euchelus lamberti* Souverbie.
angulatus Pease.
* *rubus* A. Adams.
Angaria delphinus Linné.
* *Ethalia pulchella* A. Adams.
* *guamensis* Quoy & Gaimard.
Phasianella variegata Lamarck.
* *Alcyna australis* Hedley.
Turbo petholatus Linné.
† *speciosus* Reeve.
concinnus Philippi.
Astralium petrosum Martyn.
* *aureolum* Hedley.
† *Callomphala lucidum* Adams & Angas.
Teinostoma involutum Hedley.
oppletum Hedley.
* *qualum* Hedley.
† *Cirsonella weldii* Ten.Woods.
* *Cyclostrema cubitale* Hedley.
† *Liotia peronii* Kiener.
* *crenata* Kiener.
* *scalaroides* Reeve.
† *minima* Ten.Woods.
rostrata Hedley.
* *latebrosa* Hedley.
* *Moerchia introspecta* Hedley.
† *Leptothyra nanina* Souverbie.
laeta Montrouzier.
Nerita melanotragus Smith.
plicata Linné.

Nerita chamæleon Linné.
albicilla Linné.
polita Linné, var. *australis* Wood.
Neritina souverbiana Montrouzier.
† *Helcioniscus illibratus* Verco.
† *Acmaea costata* Sowerby.
† *Phenacolepas cinnamomea* Gould.
Planaxis sulcatus Lamarck.
Rissoa cheilostoma Ten.Woods.
novarensis Frauenfeld.
* *liddelliana* Hedley.
* *Onoba glomerosa* Hedley.
Amphithalamus jacksoni Brazier.
* *capricorneus* Hedley.
* *Anabathron contortum* Hedley.
* *ascensum* Hedley.
† *Epigrus verconis* Tate.
xanthias Watson.
† *dissimilis* Watson.
Scaliola caledonica Crosse.
bella A. Adams.
arenosa A. Adams.
Rissoina cardinalis Brazier.
elegantula Angas.
crassa Angas.
inconspicua Brazier.
inermis Brazier.
miranda A. Adams.
† *obeliscus* Recluz.
* *kesteveni* Hedley.
Obtortio fulva Watson.
Alaba flammea Pease.
goniochila A. Adams.
Diala martensii Issel.
semistriata Philippi.
* *Cithna marmorata* Hedley.

† *Amalthea conica* Schumacher.
barbata Sowerby.
Cheilea equestris Linné.
Pyrazus morus Lamarck.
† *Cerithium graciliforme* Sowerby.
columna Sowerby.
zebrum Kiener.
* *Ataxocerithium abbreviatum* Brazier.
Clava pulchra A. Adams.
vertaga Linné.
* *Plesiotrochus pagodiformis* Hedley.
* *Mathilda oppia* Hedley.
† *Cerithiopsis angasi* Semper.
ridicula Watson.
Triphora dolicha Watson.
* *rubra* Hinds.
rufula Watson.
† *kesteveni* Hedley.
† *labiata* A. Adams.
corrugata Hinds.
* *funebris* Jousseaume.
* *cornuta* Hervier.
* *Turritella captiva* Hedley.
Modulus tectus Gmelin.
† *Cæcum amputatum* Hedley.
† *lilianum* Hedley.
succineum De Folin.
† *Strebloceras cygnicollis* Hedley.
Crossea gatliffi Hedley.
* *inverta* Hedley.
* *Fossarus brumalis* Hedley.
Lippistes blainvilleanus Petit.
gracilentus Brazier.
* *zodiacus* Hedley.
* *Siliquaria trochlearis* Mörch.
† *Recluzia hargravesi* Cox.

Vanikoro cancellata Gmelin.
Xenophora solarioides Reeve.
Strombus luhuanus Linné.
urceus Linné.
campbelli Gray.
* *gibberulus* Linné.
Pterocera lambis Linné.
† *Atlanta fusca* Eydoux & Souleyet.
† *rosea* Eydoux & Souleyet.
Epitonium dentiscalpium Watson.
† *bicarinatum* Sowerby.
* *revolutum* Hedley.
† *Pyramidella turrita* A. Adams.
terebelloides A. Adams.
* *mitralis* A. Adams.
† *Syrnola tincta* Angas.
† *Oscilla tasmanica* Ten.Woods.
Odostomia oodes Watson.
* *metata* Hedley.
clara Brazier.
compta Brazier.
corpulenta Watson.
convoluta Watson.
* *canaria* Hedley.
† *Odostomia rubra* Pease.
* *bulbula* Hedley.
* *sigma* Hedley.
opaca Hedley.
henni Brazier.
Pyrgulina umeralis Hedley.
zea Hedley.
* *gliriella* Melvill & Standen.
senex Hedley.
Turbonilla aplini Brazier.
cheverti Hedley.
† *varicifer* Tate.

Eulima acerrima Watson.
campyla Watson.
nitens Brazier.
latipes Watson.
† *Melanella petterdi* Beddome.
* *Mucronalia bizonula* Melvill.
* *Stilifer orbiculatus* Hedley.
* *auricula* Hedley.
Eulimella coacta Watson.
* *columna* Hedley.
† *Cingulina spina* Crosse & Fischer.
† *Torinia variegata* Gmelin.
dorsuosa Hinds.
* *Omalaxis radiata* Hedley.
Gyrineum pusillum Broderip.
Tonna variegata Lamarck.
Natica gualteriana Recluz.
chinensis Lamarck.
† *subcostata* Ten.Woods.
* *buriasensis* Recluz.
Polinices flemingianus Recluz.
conicus Lamarck.
Cypraea vitellus Linné.
tigris Linné.
subviridis Reeve.
caput-serpentis Linné.
neglecta Sowerby.
felina Gmelin.
errones Linné.
caurica Linné.
lynx Linné.
moneta Linné.
var. *annulus* Linné.
punctata Linné.
Trivia globosa Gray.
scabriuscula Gray.

† *Erato lachryma* Gray.
angistoma Sowerby.
* *nana* Reeve.
† *Ovula margarita* Sowerby.
Radius angasi A. Adams.
Scaphella pulchra Sowerby.
maculata Swainson.
Cymbium diadema Lamarck.
† *Lyria deliciosa* Montrouzier.
† *Olivella nympha* Adams & Angas.
† *Ancilla oblonga* Sowerby.
Marginella ovulum Sowerby.
† *mustelina* Angas.
† *ochracea* Angas.
brachia Watson.
† *Cancellaria costifera* Sowerby.
Conus glans Hwass.
ebraeus Linné.
* *lividus* Hwass.
millepunctatus Linné.
coronatus Dillwyn.
nussatella Linné.
vitulinus Hwass.
Turris acuta Perry.
* *Glyphostoma strombillum* Hervier.
* *rugosum* Mighels.
* *polynesiense* Reeve.
* *vultuosum* Reeve.
† *Daphnella cassandra* Hedley.
† *excavata* Gatliff.
daphnelloides Reeve.
* *Clathurella tessellata* Hinds.
* *tincta* Reeve.
* *thespesia* Melvill & Standen.
* *edychroa* Hervier.
* *Thala adumbrata* Souverbie.

Vasum turbinellum Linné.
Tudicula armigera A. Adams.
Megalatractus aruanus Linné.
* *Siphonalia gracillima* Adams & Reeve.
Fasciolaria filamentosa Lamarck.
Latirus australiensis Reeve.
polygonus Gmelin.
* *Peristernia lyrata* Reeve.
* *Turbinella subnassatula* Souverbie.
Mitra mitra Linné.
rufescens A. Adams.
* *cucumerina* Lamarck.
* *zephyrina* Sowerby.
* *capricornea* Hedley.
† *Tritonidea undosa* Linné.
Pisania crenilabrum A. Adams.
Engina lineata Reeve.
* *trifasciata* Reeve.
* *anaxeres* Duclos.
* *siderea* Reeve.
Colubraria antiquata Hinds.
Maculotriton bracteatus Hinds.
Arcularia dorsata Bolten.
mucronata A. Adams.
† *paupera* Gould.
* *semitexta* Hedley.
† *Cyllene pulchella* Adams & Reeve.
Pyrene digglesi Brazier.
versicolor Sowerby.
pardalina Lamarck.
merita Brazier.
laeta Brazier.
* *roseotincta* Hervier.
moleculina Duclos.
troglodytes Souverbie.
abyssicola Brazier.

† *Pyrene atkinsoni* Ten.Woods.
* *lurida* Hedley.
* *gemmulifera* Hedley.
Murex territus Reeve.
Aspella anceps Lamarck.
Thais hippocastanea Linné.
mancinella Linné.
pseudamygdala Hedley.
* *Drupa rubusidœa* Bolten.
* *porphyrostoma* Reeve.
† *chaidea* Duclos.
marginalba Blainville.
* *ozenneana* Crosse.
Pupa coccinata Reeve.
Ringicula assularum Watson.
Cylichna bizona A. Adams.
arachis Quoy & Gaimard.
granosa Brazier.
* *doliaria* Hedley.
acrobeles Watson.
leptekes Watson.
Retusa complanata Watson.
Atys cylindrica Helbling.
debilis Pease.
decora Brazier.
tortuosa A. Adams.
* *monodonta* A. Adams.
Bulla punctulata A. Adams.
† *Cylindrobulla fischeri* Adams & Angas.
* *pusilla* Nevill.
* *Volvatella pyriformis* Pease.
Cavolinia longirostris Lesueur.
Clio acicula Rang.
† *virgula* Rang.
Platydoris coriacea Abraham.

EMARGINULA CONVEXA, n.sp.

(Plate xvi., figs. 13, 14.)

Shell small, solid, with a slight spiral twist, high arched, with a narrow inrolled depressed apex which projects beyond the base. Posterior wall concave. Aperture regularly oval, its edge frilled. Sinus a long cleft; fasciole continued to the apex as a broad furrow enclosed between narrow elevated walls and latticed by spaced bars. Colour pale green and gray in indistinct concentric zones. Sculpture: about 50 close-set radial ridges, alternately larger and smaller, bear crowded beads largest at their termination and diminishing upwards. Across the narrow interstices concentric threads join bead to bead. When worn the concentric sculpture becomes more prominent. Height 1·75 mm.; length 3·1 mm.; breadth 1·95 mm.

Numerous examples from 17-20 fathoms.

MACROSCHISMA MADREPORARIA, n.sp.

(Plate xvi., figs. 4, 5, 6, 7.)

Shell small, rather thin, about twice as long as broad, ovate-oblong, moderately elevated, broadest opposite centre of perforation, then gradually tapering anteriorly, posteriorly rounded, anteriorly truncate, dorsal slope nearly half the length of the shell, gradual, with an obscure median furrow; side slopes straight, posterior slope most brief, being shorter than the eroded edge of the perforation. Colour variable, in the type, rose rays on a cream ground. Peristome sharply turned up behind, almost level in front. Perforation about the breadth of the shell, a narrow wedge-slit, sides straight anteriorly sharply meeting, posteriorly excavating a broad crescent in the shell. Sculpture: fine dense radiating threads which tend to produce beads at the intersection of equal growth-lines. Length 9·5 mm.; breadth 4·5 mm.; height 2·5 mm.

Several specimens from 17-20 fathoms.

The only record of *Macroschisma* from tropical Australia is a note by Brazier (These Proceedings, ii. 1877, p. 51) that *M. com-*

pressa Adams, was taken in 30 fathoms off Darnley Island. Probably the present species was there referred to. As no information has appeared on the growth-stages of the genus, I present a figure of a shell (fig.7) 1·85 mm. long in the *Puncturella* stage, and of another (fig.6), 2·95 mm. long, in the *Glyphis* stage, showing the evolution of the slit.

Gena ungula, n.sp.

(Plate xvi., figs. 1, 2.)

Shell oblong-ovate, small, thin, attenuated, about twice as long as broad, arched. Spire minute, flat, at right angles to the shell's length, terminal, of two whorls. Colour white with irregular crimson splashes spirally arranged along the back. Sculpture: fine spiral grooves decussated by growth-lines. Peristome nearly in one plane, angled above. Columella slightly thickened. Length 3·4 mm.; breadth 1·65 mm.

A few specimens from 17-20 fathoms.

The small size, narrowness and conspicuous painting seem to separate this from others of the genus.

Clanculus granti, n.sp.

(Plate xix., figs. 45, 46.)

Shell solid, umbilicate, conical, pointed at the apex, slightly angled on the shoulder, rounded at the periphery and flattened on the base. Whorls seven. Colour, on the last three whorls, oblique and zigzag brick-red stripes extending from suture to periphery; between these as well as on apex and base, pale cream. Sculpture: the third, fourth and fifth whorls carry distinct spiral grooves latticed by oblique threads, which do not cross the intervening ridges. On the latter whorls this sculpture gradually fades away, leaving the last whorl smooth and polished. Around the axis on the base run four profound spiral grooves, the outer deepest, separated by smooth, prominent, narrow cords. Umbilicus narrow, bounded by a tuberculate rib, within which it is excavate, and spirally ascends the full height of the shell's

interior. Aperture very oblique, rhomboidal. Outer lip sharp, bevelled within and carrying a strong deep-seated tubercle. Parietal callus coarsely wrinkled. Columella spirally ascending the umbilicus, terminating anteriorly in a massive bifid tooth, and higher up supporting a small tubercle. Height 9 mm.; major diameter 9·5 mm.; minor diameter 8 mm.

A single perfect shell was gathered dead near high water mark on the sand at the western extremity of the islet by the late Mr. F. E. Grant. He regarded it with interest and was pleased that it should bear his name. The grooved centre of the base and smooth body whorl are recognition marks which distinguish it from other Australian species.

GIBBULA MACCULLOCHI, n.sp.

(Plate xx., figs. 50, 51, 52.)

Shell small, very solid, depressedly-globose, subcarinate. Colour dull white, radially painted with flames of black or chocolate, which persist more on ribs than interstices. Whorls six. Sculpture: above the periphery six subgranose spiral ribs, elevated, widely spaced, increasing in size from the suture to the periphery and ascending the spire. Interstices occupied by one or two spiral threads and roughened by fine radial growth-lines. On the base, eight similar spiral cords decreasing in size from the periphery to the umbilicus. Aperture slightly but suddenly descending, subquadrate. Inner edge bevelled, of a dull callus, radiately plicate, the margins united by a thick layer of callus, within brilliantly nacreous. An expansion of the columella slightly intrudes upon the umbilicus, which is narrow but deep, margined by a crenulate rib, internally with two deep-seated funicles. Height 5·0 mm.; major diameter 6·5 mm.; minor diameter 5·5 mm.

Common alive under loose coral blocks at low tide on Mast Head Reef. I met it again, though less abundantly, in similar situations on the Cairns Reef.

The novelty has a general likeness to the New Caledonian *G. danieli* Crosse, but is larger and differently painted. It more

closely resembles the Cingalese *G. blanfordiana* G. & H. Nevill, from which the umbilical funicle distinguishes the Queensland shell.

Monilea tropicalis, n.sp.

(Plate xvi., fig.12.)

Shell small, rather thin, depressedly conical, widely umbilicate. Colour grey, turning to pink on the last whorl, a few scattered crimson dots on the larger ribs. Whorls 4½, the spire biangulate, last whorl angled at shoulder, periphery and base. Sculpture: a well-developed spiral rib girdles the periphery, parted from this by broad interspaces runs a similar one above and another below. On the base are four smaller spirals followed by a larger granulate rib which borders the umbilicus. Within the broad and deep umbilicus continues a succession of granose spirals. The flat subsutural shelf is traversed by radial plications and the whole shell is overrun by dense, fine, radial threads. Aperture subcircular, simple. Height 3·15 mm.; major diameter 3·75 mm.; minor diameter 3·0 mm.

A single specimen from 17-20 fathoms.

Calliostoma trepidum, n.sp.

(Plate xvi., fig.3.)

Shell small, thin, glossy and showing a nacreous lustre externally. Whorls five, rounded, separated by a furrowed suture; apex minute, rather tilted, unsculptured, of a whorl and a half. Colour, pale purple on the spire, last whorl pearl-grey with small scattered orange dots. Sculpture: on the base are eight spiral beaded cinguli parted by narrow grooves; at the periphery the sculpture changes abruptly; above this on the last whorl are six narrow elevated crowded cinguli, the upper bordering the suture, each bearing small sharp prominent tubercles, set in obliquely-descending rows. On the upper whorls the cinguli are fewer and the tubercles proportionately larger. Aperture rhomboidal, throat furrowed by the imprint of external sculpture, lip sharp, serrate by the sharp ends of the revolving sculpture. Columella

broadening distally, with a large blunt tubercle on its outer edge. Above this is a narrow but deep axial groove. Height 4·5 mm.; major diameter 3·75 mm.; minor diameter 3·35 mm.

Several specimens from 17-20 fathoms. A broken specimen occurred to me off the Hope Islands.

This seems to be a close ally of *C. deceptum* Smith,* from W. Australia, Port Darwin and Albany Island. His drawing is too indistinct to use except as a silhouette, but it indicates that the whorls are more angled above and below than in the Mast Head shell. Presuming that the latter are adult, the species is smaller with fewer whorls. A more distant relation is *Calliostoma spinulosum* Tate.†

Alcyna australis, n.sp.

(Plate xviii., fig.29.)

Shell small, broadly conical. Whorls four and a half, rounded, rapidly increasing. Colour: adult whorls dull white, protoconch dark purple. Sculpture: the base is ornamented with spaced spiral grooves; these occur, but fainter, on the penultimate whorl. The protoconch, embracing two and a half whorls, is more strongly spirally furrowed. Aperture large, round; into it projects from the columella a prominent tooth-like tubercle. Height 2·5 mm.; breadth 1·45 mm.

A single rather worn specimen from 17-20 fathoms is the first representative of the genus to be reported from Australia. The contrast in colour and sculpture between the apical and succeeding whorls distinguishes this species.

Astralium aureolum, n.sp.

(Plate xxi., figs.56, 57, 58.)

Shell large, massive, conical, imperforate; spire elevate, later whorls becoming subscalar. Whorls seven. Colour a uniform

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* Smith, Proc. Malacol. Soc. iii. 1899, p. 312, fig.5, and Zool. Coll. Alert, 1884, p.72.

† Tate, Trans. Roy. Soc. S.A. xvii. p.195, Pl. i. fig.7.

dull brick-red, except a brilliant cadmium-orange ring round the aperture. Sculpture: the earlier whorls are strongly radiately plicate below the sutures; periphery armed with short, broad, downwardly directed spines becoming obsolete towards the aperture; on the penultimate whorl they number sixteen. Close spiral cords densely beset with imbricating scales cover the surface of the shell; above there are ten cords carrying more distant hooded scales obliquely connected with those above and below. On the base there are also ten cords with more crowded scales. Base flattened. Aperture very oblique, subcircular, within and upon the columella pearly; a narrow inner margin to the lip continuous with an axial callus pad is bright cadmium-orange. Operculum pale orange, oblong, nucleus subterminal, hollow medially between two ribs, one of which rises proximally into a heavy callus mound. Height 87 mm.; major diam. 92 mm.; minor diam. 80 mm.

A single living and adult specimen from 20 fathoms a few miles south of Mast Head. This, the prize of the Expedition, and probably the handsomest shell discovered anywhere during the year, was captured in the last haul of the dredge. In size and general appearance it is comparable to *A. sulcatum* Martyn, from New Zealand, and may be classed as a second member of the subgenus *Cookia*. The subscalar whorls, peripheral thorns and orange mouth of *A. aureolum* distinguish it. I am indebted to my friend and colleague, Mr. A. R. McCulloch, for an excellent figure of this splendid shell.

CYCLOSTREMA CUBITALE, n.sp.

(Plate xvi., fig.8.)

Shell minute, thin, translucent, conical, perforate. Colour white. Whorls four, the first two rounded, smooth. Sculpture: a dozen prominent, distant, thin radial ribs descend the last two whorls perpendicularly, broadening at the periphery; these there produce a marked angle to the contour of the shell. Spiral threads lattice the interspaces and denticulate the edges of the ribs. Aperture round, adherent anteriorly to the body-whorl for

a short space. Outer lip formed by the last radial rib, inner a little expanded and reflected. Umbilicus a narrow perforation. Height 1·15 mm.; breadth 0·8 mm.

Several specimens from 17-20 fathoms.

LIOTIA LATEBROSA, n.sp.

(Plate xvi., fig.11.)

Shell small, globose, perforate. Colour buff. Whorls three, flattened beneath the suture, thence rounded to the base. Sculpture: about twenty radial puckers undulate the summit of the last whorl, but disappear before reaching the periphery. Around the umbilicus about a dozen similar radial riblets are disposed. Fine close spiral threads parted by grooves of equal height and breadth ornament the entire surface. Aperture simple, subcircular, slightly angled anteriorly and posteriorly. Umbilicus deep and narrow. Operculum externally concave, shelly and multispiral. Its whorls answering to those of the shell, parted by a deep sutural furrow and radially sculptured by irregular raised lines. Height 1·35 mm.; major diam. 1·45 mm.; minor diam. 1·1 mm.

Numerous specimens from 17-20 fathoms.

The shell resembles *Leptothyra*, but the operculum is of a different type. It seems to me probable that neither *Leptothyra* nor *Collonia* occurs in Australasian seas, and that the species which have been ascribed to them ought to be transferred to *Liotia*.

MOERCHIA INTROSPECTA, n.sp.

(Plate xx., figs.47, 48, 49.)

Shell small, solid, hemispherical, bluntly keeled at the base, rounded above. Colour white. Whorls four, parted by a furrowed suture, rather rapidly increasing, first two descending, third tilted, fourth inflated, at first ascending then suddenly descending to the margin of the base, so that the spire projects obliquely in a cavity formed by the ascent of the body-whorl. Sculpture: the earlier whorls are smooth and glossy, the last

wrinkled towards the suture and ornamented throughout by fine close radial hair-lines. Base slightly concave, the plane of the periphery continued in the aperture, a small umbilicus corresponding to the spire. Aperture horizontal-oblong, adnate to the keel, thickened externally. Major diam. 2·25 mm.; minor diam. 1·6 mm.; height 0·9 mm.

This species, common in 17-20 fathoms around Mast Head, represents a genus new to Australia. The Chinese *M. morleti* Fischer,* closely resembles it, but, judging from literature, differs in sculpture, and especially by the denticulate periphery.

Rissoa novarensis Frauenfeld.

Alvania novarensis Frauenfeld, Novara Moll. p.11, pl.ii. fig.16 (1867). *Rissoa* (*Alvania*) *trajectus* Watson, Chall. Exped. Zool. xv. 1886, pl. xliv. fig.6.

This synonymy has not been previously noted, but *R. trajectus* appears to be embraced within the limits of variation of *R. novarensis*. The species thus develops a continuous range from Sydney to the Gulf of Carpentaria.

Rissoa liddelliana, n.sp.

(Plate xvii., fig.24.)

Shell minute, thin, translucent, conical, perforate. Whorls four, rounded. Colour white. Sculpture: the first two whorls are smooth, the others ornamented by elevate lamellæ which continue across the suture and traverse the whole whorl. On the body-whorl they amount to seventeen, are prominently angled at the shoulder, less so at the base. The interstices are broad and flat, traversed by regular dense spiral microscopic scratches. Aperture perpendicular, circular, entire, almost, but not quite, free from the body-whorl, fortified by a broad and thick varix. Umbilicus a small axial furrow. Height 1·25 mm.; breadth 0·8 mm.

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* Fischer, Journ. de Conch. xxv. 1877, p.202, pl. iv., fig.1; and Melvill, Proc. Malacol. Soc. vii. 1906, p.27.

A few specimens from 17-20 fathoms.

Named in honour of Mr. A. Liddell, a member of our party. The novelty is related to *R. invisibilis* Hedley (Mem. Austr. Mus. iii. 1899, p 418, fig.9) from Funafuti. The sculpture recalls *Cyclostrema*, but the few whorls and solid varix do not well agree with that genus.

ONOBA GLOMEROSA, n.sp.

(Plate xvii., fig.23.)

Shell small, solid, glossy, columnar, blunt at either end. Colour milk-white to pale ochre, yellow at the summit. Whorls five, first three turbinate, last two-thirds of the shell's total length slightly inflated, contracted at the sutures, wound obliquely. Sculpture: top whorls smooth, last two ornamented by fine flat-topped spiral riblets parted by shallow grooves of slightly greater breadth; the riblets are more crowded on the centre of the whorl. There are 20 on the last and 10 on the antepenultimate whorl. Faint growth-striæ cross riblets and grooves obliquely. Aperture round, bevelled at the edge, and thickened within but not externally. Height 2·9 mm.; breadth 1-35 mm.

Common around Mast Head. I have also seen it in shell-sand from Noosa, Queensland. It is closely related to *O. mercurialis* Watson,* but the novelty is shorter, proportionately broader, with less defined sutures.

AMPHITHALAMUS CAPRICORNEUS, n.sp.

(Plate xvii., fig.22.)

Shell minute, solid, perforate, ovate, smooth. Whorls four, contracted at the suture, inflated, rapidly increasing, last descending at the aperture. Colour cream, the upper whorls pale orange, the lower with bands of pale orange on periphery and shoulder, only the latter reappearing on penultimate whorl; these bands are visible within the aperture. Umbilicus and columella stained a much deeper orange. Sculpture: faint irregular growth-lines.

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* Watson, Chall. Rep. Zool. xv. 1886, p.600, pl. xlv., fig.12.

Aperture entire, free, though barely so, from the body-whorl subcircular, angled above; outer lip thin, a little expanded columella arched, partly reflected over the umbilicus. Bas rounded. Umbilicus narrow, deep, margined by a ridge whic runs out to the point of the pillar. Height 1·5 mm.; breadt 1·1 mm.

Dredged in abundance in 17-20 fathoms. The rich orang colour of this minute shell readily distinguishes it.

Anabathron contortum, n.sp.

(Plate xvii., fig.21.)

Shell minute, first columnar, then untwisted. Whorls five, o which the last three are adult. Protoconch of two flat whorl terminating in a heavy varix and angled by a thick upstandin spiral marginal keel, the whole resembling a *Liotia minima*, an causing the summit of the shell to be sharply obliquely truncat From the protoconch the adult shell descends almost perpendicu larly, first two whorls tightly coiled but long drawn out, th final polygonal, unscrewed and long drawn out. Colou uniform ochre. Sculpture: each whorl bears on base and shoulde a heavy spiral keel which defines an angle in the contour of th whole shell; in the penultimate the lower keel is buried by th succeeding suture of the next whorl. Fine, close, longitudina lamellate riblets traverse every whorl and render the spiral keel delicately nodose; very faint but dense spiral striæ cross th riblets. Aperture subcircular, with a broad, thick continuou varix-rim. Height 1·24 mm.; breadth 0·5 mm.

Two specimens in 17-20 fathoms.

In size and sculpture this is comparable with the type of th genus, *A. contabulatum*, from which the colour, protoconch an irregular disposition of the coils plainly separate it.

Anabathron ascensum, n.sp.

(Plate xvii., fig.20.)

Shell subulate, very solid. Whorls five, first trochiform suddenly descending to form the tightly twisted, long drawn coi

of the remainder. Colour white, pink on the summit and round the mouth. Sculpture: the first whorl is acutely angled at the shoulder; from that angle is evolved a strong projecting peripheral keel descending and enlarging till it merges in the varix. The base carries a lesser keel, reappearing as a thread above the suture of the last whorl. Fine microscopic spiral striæ overrun the whole surface. Aperture obliquely oval, surrounded by a broad and thick varix. Height 1·95 mm.; breadth 0·85 mm.

Numerous specimens dredged in 17-20 fathoms.

From *A. contabulatum* the novelty is clearly distinguished by colour, greater bulk, and the massive spiral keel.

SCALIOLA BELLA A. Adams.

A. Adams, Ann. Mag. Nat. Hist. (3) vi. 1860, p.120; Watson, Chall. Rep. Zool. xv. 1886, p.623.

This species occurred with, but in less abundance than, *S. arenosa* and *S. caledonica*. On revising the group with more material and knowledge, I would now withdraw my *S. lapillifera** from the Ellice Islands, as a synonym of *S. bella*. I have also obtained this species at Green Island near Cairns, and off the Hope Islands.

RISSOINA KESTEVENI, n.sp.

(Plate xvii., fig.25.)

Shell small, massive, ovate. Whorls five, gradate. Colour white. Sculpture: the first two whorls smooth, prominent; widely spaced arcuate radial ribs, numbering 17 on the last whorl, ascend the spire continuously and obliquely, rise into nodules on the shoulder and descend tapering in a sigmoid flexure on the base. A double peripheral girdle breaks the ribs into beads; midway down the base another spiral chain of beads occurs. A secondary microscopic sculpture of fine, distant, spiral threads overruns the whole surface. Aperture ovate, a little effuse anteriorly. Height 3·25 mm.; breadth 2·25 mm.

* Hedley, Mem. Austr. Mus. iii. 1899, p.415, fig.8.

A couple of specimens from 17-20 fathoms. A single spec men, more delicately sculptured than the type, occurred in 5-1 fathoms off the Hope Islands, North Queensland.

Named after a member of the Expedition, Mr. H. L. Kestever

Cithna marmorata, n.sp.

(Plate xviii., figs.27-28.)

Shell small, thin, hyaline, imperforate, conical. Whorls six parted by impressed sutures, rounded, but inclining to be angle at the periphery in some individuals. Sculpture: fine growtl lines. Colour: on a hyaline background are numerous narro zigzag brown radial lines. These are interrupted by a periphera band, chequered by small square opaque white dots, which ascend the spire above the suture. Aperture subquadrate, emarginat and subchannelled anteriorly, outer lip flexuous, sometimes wit an external varix; columella with a low oblique median fold an a narrow callus reflection adnate to the axis. Height 1·95 mm breadth 1·1 mm.

Common in 17-20 fathoms. I have also dredged it in 5-1 fathoms off the Hope Islands near Cooktown.

Plesiotrochus pagodiformis, n.sp.

(Plate xvii., fig.16.)

Shell small, solid, regularly conical. Whorls eight, includin the protoconch. Colour buff or white, with or without irregula chocolate streaks or dots. Sculpture: a broad, deep, periphera groove indents the body-whorl and ascends the spire; the top sid of the groove overhangs the lower, giving a pagodiform shape t the shell; the suture is wound outside the basal slope of th groove; on the earlier whorls the upper limb of this groove i pinched into a sharper keel. Broad but low radial ribs, which vary in development in different individuals, cross the whorls They are faint in the earlier whorls and grow bolder with the increase of the shell, do not continue from whorl to whorl, and amount to about seven on the last volution, are scarcely per-

ceptible below the suture, but swell towards the periphery and undulate the upper limb of the groove where they terminate. The whole surface is roughened by sharp, close, minute spiral threads, numbering about 16 on the penultimate; their interstices are latticed by radial striæ. Protoconch smooth, two-whorled, turbinate. Aperture unfinished rhomboidal, grooved within by the imprint of the spiral threads. Columella straight, its edge a trifle reflected. Canal very short and broad. Height 6 mm.; breadth 3·5 mm.

Abundant in 17-20 fathoms off Mast Head. One specimen was taken by Mr. A. U. Henn off Cape Sidmouth, Queensland, and I found it plentiful round the Hope Islands, in 5-10 fathoms.

The genus *Plesiotrochus* seems so little known to conchologists that a few remarks on it may be acceptable. It was formed by P. Fischer* for the reception of his new *P. souverbianus*, from the Loyalty Islands. The classification of the genus puzzled him; a resemblance to the Cerithiidæ caught his eye, an affinity to the Littorinidæ was mentioned, but finally, and with a mark of interrogation, he placed it in Planaxidæ. In the opinion of the majority, the genus is best suited with the Cerithiidæ.

It was suggested by Pilsbry† that *Trochus exilis* Pease,‡ from the Paumotus, should be conveyed to *Plesiotrochus*. After examining specimens from the Paumotus, the Ellice and the Loyalty Islands, I would unite *P. souverbianus* to *P. exilis* as an absolute synonym. To the same genus I now refer my *Cerithium impendens*§ from Funafuti. I would further enlarge *Plesiotrochus* by the addition of the Tasmanian *Cerithium monachus* Crosse & Fischer.|| The resemblance of the latter to *Plesiotrochus* has been remarked by Melvill & Standen.¶ Angas referred *C. monachus* to *Potamides*.** Watson's comment on his *Bittium oosimense*††

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* Fischer, Journ. de Conch. xxvi. 1878, p.212.
† Pilsbry, Man. Conch. xi. 1889, p.490.
‡ Pease, Am. Journ. Conch. 1867, p 286, pl.24, fig.7.
§ Hedley, Mem. Austr. Mus. iii. 1899, p.434, fig.23.
|| Crosse & Fischer, Journ. de Conch. 1864, p.347.
¶ Melvill & Standen, Journ. of Conch. viii. 1897, p.409.
** Angas, Proc. Zool. Soc. 1865, p.171.
†† Watson, Chall. Rep. Zool. xv. 1886, p.550.

and Pilsbry's comparison of *Bittium scalatum* Dunker,* sugg the inclusion of these Japanese species in *Plesiotrochus.* Nev has recorded the genus from the Indian Ocean.† Dr. J. C. Ve has kindly sent me the radula and operculum of *C. monach* The former (Pl. xvii., fig.18) has the rachidian plate broad, wi a slender median cusp, not reaching the basal margin, with th minute cusps aside. Laterals three, curved and hooked, t hook of the innermost denticulate. Operculum (Pl. xvii., fig.1 thin, ovate, paucispiral.

MATHILDA OPPIA, n.sp.

(Plate xvi., fig.9.)

Shell small, solid, ovate, narrowly perforate. Colour ochreo Whorls four, plus a two-whorled tilted but not immersed pro conch. Suture deeply channelled. Sculpture: on the base three spiral threads, on the periphery two prominent dist spiral keels ascend from the aperture to the protoconch. Th are traversed by strong, widely spaced, perpendicular, radial ri about seventeen to a whorl, which commence on the second ad whorl and cease a little behind the aperture; they descend fr the suture to below the periphery and at the intersection of t spirals form deep square pits. Aperture broadly ovate, outer denticulated by the ends of the spirals, inner lip narrov reflected. Height 3·35 mm.; breadth 1·45 mm.

A few specimens from 17-20 fathoms.

Related to *M. decorata* (Hedley, Mem. Austr. Mus. iv. 19 p. 352, fig. 75) but differing by fewer spirals, smaller size a different angle of the heterostrophe protoconch.

TURRITELLA CAPTIVA, n.sp.

(Plate xvii., fig.26.)

Shell of medium size, slender, slowly tapering to a fine poi angled at the periphery. Whorls fifteen. Colour dull wh

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* Pilsbry, Cat. Mar. Moll. Jap. 1895, p.57.

† Nevill, List Mollusca Indian Museum, 1884, p.158.

with indistinct brown dashes. Sculpture: the second or third whorl develops a spiral keel, spiral threads appear first below, then above it, later the sides flatten, then grow concave. About the ninth or tenth whorl the adult sculpture is assumed, at and after this stage the middle of the whorl is broadly constricted between an upper and a lower prominent, spiral, rounded ridge. The anterior cingulus usually splits in two on the later whorls. Both ridges and constriction are ornamented with close, minute, spiral threads. In turn these are overrun by close, thin, radial lamellæ, arcuate in the constriction, their edges making the shell harsh to the touch. Base flat, inclining to concave, smoother than the spire. Aperture subquadrate. Height 30mm.; breadth 7 mm.

Several specimens from 16-20 fathoms.

Judging from Reeve's figure the novelty most resembles *Turritella constricta*,* a species united (though probably erroneously) to *T. clathrata* Kiener, by Tryon.† *T. captiva* appears to have more whorls in less length, to be narrower in proportion, and to have the upper cingulus adjacent instead of remote from the suture.

CROSSEA INVERTA, n.sp.

(Plate xvii., fig.15.)

Shell biconical, very solid, the base produced, much exceeding the spire, which is low and gradate. Colour milk-white. Whorls four, the first minute, unsculptured, the others rapidly increasing, parted by channelled sutures. Sculpture: the upper whorls carry three thick, elevated, spiral ribs, divided by broad, deep grooves. These vanish on the last whorl, which is entirely covered by dense, microscopic spirals so crossed by radials as to give the effect of fine punctures over the whole surface. Basal funicle massive, coiled on the body-whorl like a subsidiary whorl, far extended anteriorly, its truncate extremity excavate. A small perforation occurs below the aperture in the base of the

* Reeve, Conch. Icon.v. 1849, *Turritella*, pl.x. sp.16.

† Tryon, Man. Conch.viii. 1886, p.206.

funicle. Aperture subcircular, outer lip simple, inner reflected over the umbilicus. Umbilicus superiorly a narrow spiral perforation, inferiorly a trough hollowed between the columella and funicle. Height 2·45 mm.; major diameter 2·65 mm.; minor diameter 1·8 mm.

A few specimens from 17-20 fathoms.

The novelty is nearest *C. biconica*,* than which *C. inverta* is larger, proportionately broader, with a lower spire and a heavier funicle.

FOSSARUS BRUMALIS, n.sp.

(Plate xviii., fig.38.)

Shell small, thin, globose-turbinate, widely umbilicate. Whorls four, rapidly increasing, parted by impressed sutures. Colour coffee-brown. Sculpture: spiral, elevated, narrow keels, two on the penultimate, five on the last whorl, spaced by flat interstices three times their breadth, the highest on the shoulder, the lowest margining the umbilicus; over all a secondary sculpture of fine, close, spiral microscopic striæ. First whorl smooth, dome-shaped. Umbilicus a wide funnel spirally ascending to a narrow perforation. Aperture large, subquadrate, outer lip sharp-pointed at the termination of each keel. Columella straight, slightly reflected over the umbilicus. Height 1·32 mm.; breadth 1·0 mm.

A few specimens from 17-20 fathoms. Further examples were procured in 1906 off the Hope Islands.

The sign of Capricorn was "brumalis" to the Romans though not to ourselves.

LIPPISTES ZODIACUS, n.sp.

(Plate xviii., fig.30.)

Shell small, solid, narrowly perforate, ovate. Colour pale buff. Whorls four and a half, including a protoconch of a whorl and a half. Sculpture: prominent, widely spaced spiral keels, two on each of the upper whorls and four on the last, both the keels and

* Hedley, These Proceedings, xxvii. (1902), p.12, pl. ii. fig.24.

flat interspaces smooth. Aperture ovate, toothed by the ending of the spirals. Columella narrowly reflected. Height 1·6 mm.; breadth 0·85 mm.

Several specimens from 17-20 fathoms off Mast Head.

The novelty appears to be the smallest and narrowest of its genus.

When previously discussing *Lippistes** I was unaware of an excellent review of the genus by von Martens.†

Odostomia metata, n.sp.

(Plate xviii., fig.35.)

Shell small, thin, columuar, imperforate, smooth, glossy and semitransparent. Adult whorls five, inclining to fusiform shape, narrowly tabulate at the sutures. Protoconch of two or three whorls, small, globose, wound at right angles to the adult axis, half immersed in the flat summit of the first adult whorl, within the margin of which it is contained. Colour: narrow spiral chocolate lines are ruled on a milky ground, between these are transverse bars or checkers of chocolate, a narrow opaque white margin frequently bordering the chocolate. The spiral lines are three on the last whorl, two each on the two earlier and one each on the two others. Chocolate also tinges the outer edge of the columella lip. Base well rounded. Aperture pyriform, the columella with a low oblique fold. Height 2·35 mm.; breadth 0·35 mm.

Two specimens from 17-20 fathoms.

Odostomia canaria, n.sp.

(Plate xviii., fig.32.)

Shell small, rather solid, umbilicate, elongate, conical, smooth. Colour entirely bright canary-yellow. Adult whorls five, flat-sided. Periphery with a deep groove in which runs the suture

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* These Proceedings, xxvii. p.23.

† Von Martens, Archiv f. Naturg. lxiii. 1897, p.174.

of the upper whorl, thus producing a sharp deep constrictior between the whorls. Protoconch large, projecting across the summit of the first normal whorl, and consisting of three prostrate drawn out whorls. Base inflated, well rounded. Umbilicus narrow, partly walled in by the columella. Aperture rhomboidal rather produced anteriorly, angled posteriorly. Outer lip sharp medially inflected. Just below the insertion of the columella there projects a single, large, compressed fold. Throat internally finely spirally grooved. Height 2·35 mm.; breadth 1·0 mm.

Several specimens from 17-20 fathoms.

The unusual sulphur colour will aid in the recognition of this species.

Odostomia bulbula, n.sp.

(Plate xviii., fig.34.)

Shell small, very solid, imperforate, globose, conical. Colour white. Adult whorls four, rapidly increasing, the last flattened above, subangled at the periphery, rounded on the base. Apical whorls small, wound horizontally, too deeply immersed to count the coils. Sculpture : to the naked eye smooth, but under magnification ornamented by radial spaced threads, anteriorly wrinkled over a low spiral ridge round the axis. Aperture lunate, outer lip sharp. Columella spreading as a pad over the axis and there bearing a strong, compressed, horizontally-entering fold; below this it is perpendicular, arcuate, much thickened, and slightly reflected, anteriorly meeting the outer lip in a blunt angle. Height 3·5 mm.; breadth 2·75 mm.

A single specimen from 17-20 fathoms.

The extreme corpulence of this small *Odostomia* will facilitate its recognition.

Odostomia sigma, n.sp.

(Plate xviii., fig.33.)

Shell small, rather solid, imperforate, ovate, turreted. Colour white. Whorls four, and a heterostrophe protoconch. Sculpture : fine, close, regular, radial riblets extending obliquely across the whorls in a sigmoid flexure. Aperture pyriform,

angled above, effuse below, outer lip sinuate, columella with a single prominent fold. Height 2·3 mm.; breadth 1·3 mm.

A single specimen from 17-20 fathoms, is specifically distinguished by the sculpture.

ODOSTOMIA HENNI Brazier.

Odostomia henni Brazier, These Proceedings (2), ix. 1894, p.171, pl.xiv. fig.2. *Pyrgulina perspectiva* Hedley, These Proceedings xxvii. 1902, p.10, pl.iii. fig.33.

On reconsideration I would now withdraw my *P. perspectiva* as a synonym of *O. henni*. A series from 17-20 fathoms off Mast Head supplies a locality intermediate between those hitherto recorded. I find that I also took this species under stones at low water in Port Moresby, Papua, in 1890.

MUCRONALIA BIZONULA Melvill.

Melvill, Proc. Malacol. Soc. vii. 1906, p.72, pl.viii. fig.31.

A single immature shell from 17-20 fathoms off Mast Head corresponds well to the account of one recently described by Mr. J. C. Melvill from the Persian Gulf.

STILIFER ORBICULATUS, n.sp.

(Plate xviii., fig.37.)

Shell small, globose, narrowly perforate. Whorls six, rapidly increasing; first two stiliform, third and fourth sharply angled on the shoulder, last two rounded. Sculpture: low radial undulations crossed by minute incised spiral lines. Colour pale yellow, warming to orange on the spire. Aperture pyriform, lip sharp, a thin callus on the body-whorl. Columellar margin reflected over a narrow perforation. Height 4·4 mm.; breadth 4·4 mm.

One weathered shell from 17-20 fathoms.

STILIFER AURICULA, n.sp.

(Plate xviii., fig.36.)

Shell minute, turbinate, with a subulate spire. Colour white. Whorls six, the final one swollen, globose; the penultimate much

narrower, gradate; the earlier together forming a tall and slende column. No sculpture. Umbilicus wide and deep. Apertur semilunate, lip expanded, columellar margin broadly reflected Height 2·15 mm.; breadth 1·65 mm.

Three specimens from 17-20 fathoms. I again met with thi species in 5-10 fathoms off the Hope Islands.

EULIMELLA COLUMNA, n.sp.

(Plate xviii., fig.31.)

Shell minute, long and slender, turreted, terminating obtusely Whorls seven, plus an inclined heterostrophe protoconch, angle at the periphery, slowly increasing. Colour translucent white Sculpture: above the angle are no spirals, at and below i numerous spiral grooves, finer and crowded at the angle, deepe and wider spaced below it. Across these and the smooth bel between the angle and suture run fine flexuous growth-lines Base rounded, imperforate. Aperture pyriform, outer lip sharp columella expanded. Height 2·3 mm.; breadth 0·75 mm.

Numerous specimens from 17-20 fathoms. This species als occurred in 5-10 fathoms off the Hope Islands.

This is most nearly related to *E. anabathron* Hedley,* fron which it is distinguished by the spiral grooves, which appear a opaque lines on a translucent ground.

OMALAXIS RADIATA, n.sp.

(Plate xx., figs.53, 54, 55.)

Shell minute, thin, discoidal, angled above and below; spir slightly raised, umbilicus broad and deep. Colour white. Whorl three, subquadrate in section, last finally detached. Protoconch of one tilted and unsculptured whorl ending in a varix. Sculp ture: fine, close, lamellate, radial ribs, about 52 on last whorl crossing the upper and lower angles these thicken and project

* These Proceedings, xxx. 1906, p.524, pl.xxxiii., figs.39, 40.

as denticles. Aperture unfinished, free. Height 0·6 mm.; major diam. 1·3 mm.; minor diam. 0·9 mm.

Abundant in 17-20 fathoms off Mast Head.

Judging from literature, this species appears to resemble the the Sicilian *O. zanclea* Philippi, from which the size, sculpture and elevation of the spire separate it.

DAPHNELLA EXCAVATA Gatliff.

Gatliff, Proc. Roy. Soc. Vict. xix. (n.s.), 1906, p.1, pl.i., fig.1.

The occurrence of a shell recently described from Victoria was unexpected, but a good series taken in 17-20 fathoms off Mast Head corresponds exactly to authentic examples kindly supplied by Mr. J. H. Gatliff. This extension of range suggests that it may in future be detected in New South Wales. The species somewhat resembles *Clathurella hirsuta* de Folin, in miniature.

MITRA MITRA Linné.

Voluta mitra var. *episcopalis* Linné, Syst. Nat. x. 1758, p.732.

A single worn example from the beach probably represents the southern limit of the shell. Linné compounded his species of two "varieties," *episcopalis* and *papalis*. It seems to me, but not to my predecessors, that when *papalis* was withdrawn as a separate species, the specific *mitra* reverted to the residual.

An addition to Australia is *Mitra zephyrina* Sowerby,* of which I dredged a fragmentary specimen in 17-20 fathoms.

Digressing from the Capricornian fauna, this opportunity may be taken of recording another *Mitra* new to Australia, *M. bernhardina* Bolten, which I gathered at Green Island, off Cairns. It was named in the rare 'Museum Boltenianum'† from a figure by Chemnitz.‡ Thirteen years afterwards Lamarck established,§ on the same figure, his *Mitra muriculata*, a name by which the species is generally known.

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* Sowerby, Thes. Conch. iv. 1874, p.4, pl.368, fig.307.
† Bolten, Museum Boltenianum, 1798, p.136.
‡ Chemnitz, Conch. Cab. x. 1788, pl.150, fig.1427.
§ Lamarck, Ann. du Mus. xvii. 1811, p.216.

MITRA CAPRICORNEA, n.sp.

(Plate xvi., fig.10.)

Shell minute, slender, conical, solid. Whorls five, of which two compose the protoconch. Colour: various shades of brown from chocolate to ochre, or lilac, usually monochrome, but sometimes with two narrow spiral dark lines on the upper whorls. Sculpture: protoconch smooth, remainder with broad, wave-like well spaced, radial ribs, about eleven to the whorl, which undulate the suture, continue from whorl to whorl and vanish on the base. The last third of the body-whorl is without ribbing. Aperture narrow, columella quadruplicate, the folds diminishing rapidly in size downwards, a thick callus layer on the inner lip, a stout tubercle beneath the hook of the right insertion, about six deep-seated spiral lyræ on the parietal wall. Height 3·85 mm.; breadth 1·75 mm.

Several specimens from 17-20 fathoms.

The form varies; some are stouter, others more slender. In general appearance the novelty is like *M. nitidissima* Melvill & Standen, from Lifu, but is distinguished by ribbing and duller surface.

COLUBRARIA ANTIQUATA Hinds.

Triton antiquatus Hinds, Proc. Zool. Soc. 1844, p.21.

This species ranges from Torres Straits, whence it was reported by Melvill & Standen,* south to Sydney. Brazier has named specimens from New South Wales *Triton coxi*† and others from Queensland *Tritonium angasi*.‡ Pease has added a synonym in *Triton crenulatus*.§ The generic position of the species was lately revised by Dr. Dall.||

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* Melvill & Standen, Journ. Linn. Soc. Zool. xxvii. 1899, p.163.

† Brazier, Proc. Zool. Soc. 1872, p.22, pl.iv., fig.9.

‡ Brazier, These Proceedings, i. 1877, p.174.

§ Pease, Amer. Journ. Conch. iii. 1867, p.233.

|| Dall, Smithsonian Miscell. Coll. xlvii. 1905, p.135.

ARCULARIA DORSATA Bolten.

Buccinum dorsatum Bolten, Mus. Bolt. (2) 1798, p.111, for Martini, Conch. Cab. iv., pl.cxxv., figs. 1194, 1195.

For this species F. P. Marrat has recommended* the name of *Nassa trifasciata* Gmelin. Probably he did not observe that Gmelin duplicated this name by proposing *Buccinum trifasciatum* first on Syst. Nat. xiii. p.3477, for *Cassidea granulata* Born, and then again on p.3489 for this species. So Gmelin's name is obliterated by himself.

Next in order appears to be the name of Bolten, which, founded on a figure of the Conchylien Cabinet, recognised as applicable to our shell by E. A. Smith,† precedes the names which Brazier‡ has enumerated, *N. livida* Gray, *N. unicolor* Kiener, etc.

Roth states§ that the Batavia River Blacks eat the mollusc and call it "tru-no."

ARCULARIA SEMITEXTA Hedley.

Nassa semitexta Hedley, Mem. Austr. Mus. iii. 1899, p. 462, fig.37.

This species was discovered in the Ellice Islands; its taxonomic position is still a matter of uncertainty. A single broken individual, half the size of my type from Funafuti, extends its range to Australia.

PYRENE ABYSSICOLA Brazier.

Columbella abyssicola Brazier, These Proceedings, i. 1877, p.232.

(Plate xix., figs. 40, 41, 42, 43.)

The shell figured for this species by Tryon‖ does not agree with the description or with the authentic specimens that I have

* Marrat, Journ. of Conch. ii. 1879, p.78.

† Smith, Zool. Coll. Alert, 1884, p.48.

‡ Brazier, These Proceedings, x. 1886, p.86.

§ Roth, North Q'ld. Ethnography, Bull. iii. 1901, p.18.

‖ Tryon, Man. Conch. v. 1883, p.141, pl.51, fig.65.

examined. His figure was possibly based on *Pyrene melvil* Hedley* (= *Columbella subphilodicia* Hervier), which I took i 5-10 fathoms off the Hope Islands. The two species have general resemblance, but in *P. abyssicola* the colour is dispose in angles, while in *P. melvilli* it takes the form of bars. Th species is abundant in 17-20 fathoms round Mast Head; th collection is divisible into two series, probably sexual, of stouter and of a more slender form. These are shown in th accompanying drawings from the brush of my friend, Mr. A. R McCulloch.

PYRENE LURIDA, n.sp.

(Plate xvii., fig.19.)

Shell small, oval, thin, semitransparent, glossy. Whorls fiv slightly shouldered. Colour, uniform, clear cinnamon-brow with a pale, narrow, peripheral zone. Sculpture: the anteri extremity is wound round with ten small spiral cords; th remainder at first appears smooth, but on high magnification found to have minute spiral striæ reticulated by delicate growt lines. Aperture oblong, outer lip thickened externally and wit three tubercles internally. Columella smooth, straigh Height 3·4 mm.; breadth 1·5 mm.

A few imperfect specimens were dredged in 17-20 fathoms o Mast Head Island. I have derived my figure from a perfe example gathered by the late Mrs. Starkey in Middle Harbou Sydney.

PYRENE GEMMULIFERA, n.sp.

(Plate xix., fig. 44.)

Shell small, narrowly ovate, very solid, slightly turrete Colour uniform chocolate-brown. Whorls five, of which tw compose the protoconch. Sculpture: second whorl of the prot conch with fine radial riblets, adult whorls with elevate continuous, perpendicular ribs, about twenty to a whorl. Thes

*Hedley, Mem. Austr. Mus. iii. 1899, p.463, fig.38.

are cut into beads by similar spirals, of which the antepenultimate and penultimate have each four, and the last whorl nine, besides four unbeaded ridges at the anterior end. The bead-row below the suture is marked off from the rest by a deeper furrow. Aperture narrow, lip thickened externally, armed within by five denticles. Height 2·7 mm.; breadth 1·15 mm.

Numerous specimens in 17-20 fathoms. The species is smaller and more ovate than others of the genus which have reticulate sculpture.

DRUPA RUBUSIDÆA Bolten.

Drupa rubusidæus Bolten, Mus. Bolten. (2), 1798, p.55 (based on Knorr, vi. t.24, fig.7).

Among rocks on the weather-edge of the reef at low water we found alive a shell which approaches nearer to the illustration of *Ricinula reeveana* Crosse* than to any other published figure. An examination of Crosse's type enabled E. A. Smith to pronounce it a variation of "*Sistrum hystrix* Lamarck."† But Lamarck's *Pupura hystrix* ‡ is merely a misinterpretation of *Murex hystrix* Linné.§ For Hanley || in his exposition of Linnean types writes, that "*Murex hystrix* of Linnæus . . . . must assuredly be regarded as an immature example of *ricinus*."

Failing an earlier synonym, after discarding *hystrix*, it would be necessary to employ *reeveana*. But Deshayes and Kuster regarded *Purpura spathulifera* Blainville (1832), as equivalent to *hystrix* of Lamarck.

Antecedent even to the name of Lamarck is the *Drupa rubusidæus* of Bolten, whose citation of Knorr and Martini coincides with the quotations of his successor. Bolten's name must therefore stand for the common tropical shell familiarly known as *Ricinula hystrix*.

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* Crosse, Journ. de Conch. x. 1862, p.47, pl. i. fig.2.
† Smith, Proc. Malacol. Soc. ii. 1897, p.230.
‡ Lamarck, An. s. vert. vii. 1822, p.247.
§ Linn., Syst. Nat. x. 1758, p.750.
|| Hanley, Ips. Linn. Conch. 1855, p.295.

CYLICHNA DOLIARIA, n.sp.

(Plate xviii., fig.39.)

Shell small, solid, cask-shaped, perforate at either end. Colour milk-white zoned with alternate opaque and semitransparent, spiral bands. Sculpture: nineteen sharp, narrow, deep, spiral grooves are interposed between broad flat-topped ribs. Under a high magnification the ribs are seen to be set with fine longitudinal grains, whose ends undulate the grooves. Summit flat, excavate within, spirally descending to a narrow perforation. Base with a comparatively large umbilicus, which at the penultimate whorl contracts to a similar narrow hole. Aperture regularly arched. Columella subdentate below. Height 2·35mm.; breadth 1·55 mm.

The novelty is related to *C. granosa* Brazier (=*reticulata* Watson), *C. pulchra* Brazier (=*subreticulata* Watson), and *C. bizona* A.Ad. From this group it is distinguished by broader form and absence of colour.

Plentiful in 17-20 fathoms. A smaller form was taken near the Hope Islands, North Queensland, in 5-10 fathoms.

EXPLANATION OF PLATES.

Plate xvi.

Figs.1, 2.—Interior and exterior of *Gena ungula* Hedley.
Fig.3.—*Calliostoma trepidum* Hedley.
Figs.4, 5, 6, 7.—Adult and growth-stages of *Macroschisma madreporaria* Hedley.
Fig.8.—*Cyclostrema cubitale* Hedley.
Fig.9.—*Mathilda oppia* Hedley.
Fig.10.—*Mitra capricornea* Hedley.
Fig.11.—*Liotia latebrosa* Hedley.
Fig.12.—*Monilea tropicalis* Hedley.
Figs.13, 14.—*Emarginula convexa* Hedley.

Plate xvii.

Fig.15.—*Crossea inverta* Hedley.
Fig.16.—*Plesiotrochus pagodiformis* Hedley.

Figs. 17, 18.—Operculum and radula of *Plesiotrochus monachus* Crosse & Fischer.

Fig. 19.—*Pyrene lurida* Hedley.

Fig. 20.—*Anabathron ascensum* Hedley.

Fig. 21.—*Anabathron contortum* Hedley.

Fig. 22.—*Amphithalamus capricorneus* Hedley.

Fig. 23.—*Onoba glomerosa* Hedley.

Fig. 24.—*Rissoa liddelliana* Hedley

Fig. 25.—*Rissoina kesteveni* Hedley.

Fig. 26.—*Turritella captiva* Hedley.

Plate xviii.

Figs. 27, 28.—*Cithna marmorata* Hedley.

Fig. 29.—*Alcyna australis* Hedley.

Fig. 30.—*Lippistes zodiacus* Hedley.

Fig. 31.—*Eulimella columna* Hedley.

Fig. 32.—*Odostomia canaria* Hedley.

Fig. 33.—*Odostomia sigma* Hedley.

Fig. 34.—*Odostomia bulbula* Hedley.

Fig. 35.—*Odostomia metata* Hedley.

Fig. 36.—*Stilifer auricula* Hedley.

Fig. 37.—*Stilifer orbiculatus* Hedley.

Fig. 38.—*Fossarus brumalis* Hedley.

Fig. 39.—*Cylichna doliaria* Hedley.

Plate xix.

Figs. 40, 41, 42, 43.—*Pyrene abyssicola* Brazier, showing dimorphism, probably sexual.

Fig. 44.—*Pyrene gemmulifera* Hedley.

Figs. 45, 46.—*Clanculus granti* Hedley.

Plate xx.

Figs. 47, 48, 49.—*Moerchia introspecta* Hedley.

Figs. 50, 51, 52.—*Gibbula maccullochi* Hedley; and enlarged sculpture.

Figs. 53, 54, 55.—*Omalaxis radiata* Hedley.

Plate xxi.

Figs. 56, 57, 58.—*Astralium aureolum* Hedley; with operculum. Nat. size.

REVISION OF THE AUSTRALIAN SPECIES OF THE GENUS *ANTHOBOSCA* (FAMILY SCOLIIDÆ) WITH DESCRIPTIONS OF NEW SPECIES.

[*Hymenoptera.*]

By Rowland E. Turner, F.E.S.

Genus Anthobosca Guér.

Anthobosca Guér., Voy. Coq. ii. 2, p.214, 1830 (1839).

Cosila Guér., l.c. p.249; Sichel, Sauss. et Sich., Spec. Gen. Sco p.259, 1864; Sauss., Grandidier, Hist. Madagascar, xx. P.2, p.23 1892.

Myzine (partim) Sm., Cat. Hym. B.M. iii. 69, 1855; Dalla Torr Cat. Hym. viii. 1897.

Dimorphoptera Sm., Trans. Ent. Soc. Lond. 1868, p.238.

By careful comparison with exotic species in the Britis Museum Collection, I have convinced myself that the insec classed in the genus *Anthobosca* are the male sex of the insec usually known in Australia as *Dimorphoptera* Sm. Smith hin self described a single male as belonging to his genus, which undoubtedly an *Anthobosca*; but did not compare it in any wa with other males, which have hitherto been classed with the *Thy nidæ*. Although certainly forming a link between the *Scoliid* and *Thynnidæ*, the structure of the thorax in the female and th presence of wings will not allow of retention in the *Thynnid* The genus must, therefore, be placed in the *Scoliidæ*, next t *Myzine*.

The male sex is well described by Guérin, and may be di tinguished by the short, straight and stout antennæ, the unarme hypopygium and the narrowness of the second cubital cell on th radial nervure; in some species the cell is almost triangula The neuration extends to the outer margin as in *Thynnus*. Th mandibles are bidentate.

In both sexes the maxillary palpi are six-jointed, the joints usually subequal, and the labial palpi four-jointed.

In the female the shape of the second cubital cell is similar to that of the male, but the neuration does not quite reach the outer margin. The mandibles are strong and rather blunt, not bidentate. The epipygium is large and broad, usually pubescent.

In both sexes the clypeus is very short, transverse. The second and third cubital cells each receive a recurrent nervure in most of the species, but in *A. crassicornis* Sm.(♂) and *A. clypeata* Sm.(♀) both recurrent nervures are received by the second cubital cell.

The genus may be distinguished from the rest of the *Scoliidæ* by the first abdominal segment, which is not strangulated in either sex. It has a wide range over the Southern Hemisphere, occurring in S. America, S. Africa, and Madagascar; but the species seem more numerous in Australia than elsewhere.

Key to the Species of Anthobosca.

♂♂. i. Second and third cubital cells each receiving a recurrent nervure.

A. First abdominal segment slender and elongate.

a. Black; thorax and abdomen marked with yellow. Length 14 mm. — *A. australasiæ* Guér.

B. First abdominal segment not slender or elongate.

a. Wings nigro-violaceous.

a^2. Wholly black. Length 17 mm. — *A. nigripennis* Sm.

b. Wings hyaline.

a^2. Wholly black.

a^3. Median segment rounded, finely reticulate. — *A. nigra* Sm.

b^3. Median segment quadrate, rugose. — *A. aethiops* Sm.

b^2. Black; with ferruginous legs.

a^3. Wholly black, except the legs. Length 15 mm. — *A. varipes* Sm.

b^3. Posterior margin of the pronotum and the postscutellum yellow. Length 7 mm. — *A. torresensis*, n.sp.

c^2. Black; the legs black.

a^3. Posterior margin of the pronotum, the postscutellum and a spot on each side of the epipygium yellowish-white. Length 12 mm. — *A. longipalpa*, n.sp.

b^3. Posterior margin of the pronotum pale yellow. Length 7 mm. *A. frenchi*, n.sp

ii. Second cubital cell receiving both recurrent nervures.

a. Second and third abdominal segments and legs dull ferruginous. Length 11 mm. *A. crassicornis* Sm.

♀♀. i. Second and third cubital cells each receiving a recurrent nervure.

A. Wings nigro-violaceous.

a. Wholly black.

a^2. With long black pubescence on the sides of the abdomen. Length 29 mm. *A. australis* Sichel.

b^2. With thin grey pubescence on the sides of the abdomen. Length 18 mm. *A. morosa* Sm.

b. Black; the flagellum orange. Length 11 mm. *A. flavicornis* Sauss.

c. Black; a yellow spot on each side of the third abdominal segment. Length 21 mm. *A. signata* Sm.

d. Black; the abdominal segments margined with coarse, short, white pubescence. Length 14 mm. *A. albopilosa*, n.sp

B. Wings hyaline.

a. Wings clouded at apex.

a^2. Wholly black, front punctured. Length 15 mm. *A. anthracina* Sm.

b. Wings not clouded at apex.

a^2. Entirely black.

a^3. Front punctured. Length 11 mm. *A. unicolor* Sm

b^3. Front smooth and shining. Length 7 mm. *A. lævifrons* Sm

c. Wings tinged with fuscous.

a^2. Legs ferruginous. Length 11 mm. *A. cognata* Sm

d. Wings tinged with yellow, shorter than the abdomen.

a^2. Rufo-testaceous; head, mesothorax and three apical abdominal segments black. Length 17 mm. *A. fastuosa* Sm.

ii. Second cubital cell receiving both recurrent nervures.

a. Black; second, third and fourth abdominal segments rufo-testaceous, except the apical margin. *A. clypeata* Sm.

1. Anthobosca australasiæ Guérin.

A. australasiæ Guérin, Voy. Coq. Zool. ii. 2, p.237, T.8, f.8, 1830 (1839)[♂].

A. crabroniformis Sm., Cat. Hym. B.M. vii. p.59, n.4, 1859(♂).

Thynnus cathreinii D.T., Cat. Hym. viii. 103, 1897(♂).

Hab.—Sydney (G. A. Waterhouse) Richmond River, N. S. W. (Froggatt).

2. A. NIGRIPENNIS Sm.

Dimorphoptera nigripennis Sm., Trans. Ent. Soc. Lond. 1868, p.239(♂).

Myzine nigripennis D.T., Cat. Hym. viii. 125, 1897(♂).

Hab.—Australia.

3. A. NIGRA Sm.

A. nigra Sm., Cat. Hym. B.M. vii. 59, n.2, 1859(♂).

Thynnus reischii D.T., Cat. Hym. viii. 114, 1897(♂).

This species is almost entirely black, the anterior tibiæ are fuscous and the spines of the tibiæ white. Head finely punctured, thorax and abdomen finely shagreened.

Hab.—Woodford, Blue Mtns., N. S. W. (G. A. Waterhouse); Victoria (French).

4. A. AETHIOPS Sm.

A. aethiops Sm., Descr. n.sp. Hym. p.175, n.3, 1879(♂)

Thynnus stolzii D.T., Cat. Hym. viii. 116, 1897(♂).

The median segment is short, quadrate and transversely rugulose; the scutellum is truncate at the apex.

Hab.—Champion Bay, W.A.

5. A. LONGIPALPA, n.sp.

♂. Clypeus short, transverse, very slightly emarginate at the apex. Head and thorax finely shagreened; median segment very finely shagreened, shining at the apex, with a faint depressed mark on the disc near the centre. Abdomen very finely shagreened, a fine, short median sulca from the base of the first segment; the apical segment narrowly truncate at the apex. The three apical joints of the maxillary palpi are rather long, the apical one filiform and of a testaceous colour.

Black, a narrow line on the posterior margin of the pronotum, a transverse line on the postscutellum, a mark at the base of the posterior tibiæ and the spines of the tibiæ, yellowish-white; a spot on each side of the epipygium testaceous-yellow. The anterior tibiæ ferruginous, the anterior tarsi and the intermediate

and posterior tibiæ fuscous. Wings hyaline, slightly iridescent, nervures black. The second cubital cell longer along the radial nervure than in most of the genus. Length 12 mm.

Hab.—Cairns, Q.(Turner).

6. A. FRENCHI, n.sp.

♂. Head very finely punctured, the three apical joints of the maxillary palpi rather longer than the others and of a pale yellow colour. Thorax and abdomen finely shagreened. The scutellum narrowly rounded at the apex.

Black; the mandibles pale yellow, ferruginous at the apex; the posterior margin of the pronotum, the tegulæ and a spot at the base of the tibiæ pale yellow; the anterior tibiæ ferruginous, the anterior tarsi fuscous. Wings hyaline, iridescent. Length 7-8 mm.

Hab.—Victoria(French).

Nearly allied to *A. nigra* in general form, but the thorax is more slender.

7. A. VARIPES Sm.

A. varipes Sm., Cat. Hym. B.M. vii. p.59, n.3, 1859(♂).

Thynnus fischeri D.T., Cat. Hym. viii. 106, 1897.

The scutellum is subtriangular, narrowly rounded at the apex, with a delicate carina from the base nearly reaching the apex.

Hab.—Lower Plenty, Vic.; Victoria (French).

8. A. TORRESENSIS, n.sp.

♂. Head sparsely punctured, almost smooth on the vertex, the apical joints of the maxillary palpi not elongate. Pronotum smooth; the mesothorax, median segment and abdomen very finely shagreened. Scutellum broadly rounded at the apex.

Black; mandibles pale yellow, ferruginous at the apex; scape of the antennæ ferruginous beneath; a broad band on the posterior margin of the pronotum, the tegulæ, a spot on the postscutellum, a spot on each side near the apex of the median segment and the outside of all the tibiæ, pale yellow; legs light

ferruginous, coxæ and trochanters black. Wings hyaline, iridescent, nervures fuscous. The second cubital cell is very narrow along the radial nervures, subtriangular. Length 7-8 mm.

Hab.—Cape York, Q.(April and May; Turner).

9. A. CRASSICORNIS Sm.

Tachypterus crassicornis Sm., Cat. Hym. B.M. vii. 64, n.3, 1859(♂).

The second recurrent nervure is received by the second cubital cell, close to the apex. The second cubital cell is much longer along the radial nervure than in other species of the genus.

Hab.—Australia.

10. A. AUSTRALIS Sichel.

Cosila australis Sichel, Sauss. et Sich., Spec. Gen. Scol. p.261, 1864(♀).

Dimorphoptera scoliiformis Sm., Trans. Ent. Soc. Lond. 1868, 238(♀).

Myzine scoliiformis D.T., Cat. Hym. viii. 126, 1897(♀).

Hab.—Moreton Bay (Smith).

11. A. MOROSA Sm.

Dimorphoptera morosa Sm., Trans. Ent. Soc. Lond. 1868, p.239(♀).

Myzine morosa D.T., Cat. Hym. viii. 125, 1897(♀).

Hab.—Australia; Melbourne(?) (Smith).

12. A. SIGNATA Sm.

Myzine signata Sm., Cat. Hym. B.M. iii. 75, n.31, 1855(♀).

Cosila biguttata Sichel, Sauss. et Sich., Spec. Gen. Scol. p.262, n.3(♀).

Dimorphoptera signata Sm., Trans. Ent. Soc. Lond. 1868, p.238(♀).

Hab.—Sydney, N.S.W.(G. A. Waterhouse); Cairns, Q.(Turner).

13. A. FLAVICORNIS Sauss.

Cosila flavicornis Sauss., Grandidier, Hist. Madagascar, xx. P.2, p.233, 1892[♀](nec *Myzine flavicornis* Sm., 1879).

♀. Front coarsely, vertex sparsely punctured, a short, faint, longitudinal sulca from below the anterior ocellus. Pronotum

very finely and closely punctured anteriorly, more coarsely ar sparsely posteriorly, the anterior margin strongly depresse Mesothorax and scutellum sparsely punctured; median segmer opaque, reticulate, almost vertically truncate posteriorly. Abd men rather sparsely punctured, first segment broad, truncate the base.

Shining black, with grey pubescence; the flagellum of th antennæ bright orange. Wings fusco-hyaline with faint viole reflections. The second cubital cell is much produced toward the base along the cubital nervure, and is very short on th radial nervure. Length 11 mm.

Hab.—Victoria(French).

14. A. ALBOPILOSA, n.sp.

♀. Head strongly punctured, with white pubescence on th posterior margin. Thorax strongly punctured, most closely o the anterior portion of the pronotum, the pronotum covered wit long, thin, black pubescence. Median segment opaque, mo finely punctured, obliquely truncate posteriorly. Abdome densely and rather finely punctured, the apical margins of th segments above and beneath with a fringe of short, broad, scal like hairs of a silver-white colour, the sides of the segments wit long black pubescence. The fifth segment is without the whi marginal fringe, and is clothed with long black pubescenc The pygidium is broadly rounded at the apex, the apical portio bare and very finely punctured.

Entirely black, the pygidium fuscous at the apex. Wing fuscous, with very faint violet reflections at the base. Th second cubital cell is rather longer along the radial nervure an less produced towards the base along the cubital nervure than i *A. anthracina* Sm. Length 14 mm.

Hab.—Queensland. Type in B.M., ex Coll. Smith.

15. A. ANTHRACINA Sm.

Myzine anthracina Sm., Cat. Hym. B.M. iii. 71, 1855(♀); D.T Cat. Hym. viii. 121, 1897 (♀).

Dimorphoptera anthracina Sm., Trans. Ent. Soc. Lond. 1868, p.238(♀).

Myzine sabulosa Sm., Cat. Hym. B.M. iii. p.76, 1855(♀); D.T., Cat. Hym. viii. 126, 1897(♀).

Dimorphoptera sabulosa Sm., Trans. Ent. Soc. Lond. 1868, p.238(♀).

Cosila fasciculata Sichel, Sauss. et Sich., Spec. Gen. Scol. p.263, 1864(♀).

Hab.—Sydney.

Cosila inornata Sauss., Grandidier, Hist. Madagascar, xx. 233, 1892, is probably another synonym.

16. A. UNICOLOR Sm.

Myzine unicolor Sm., Cat. Hym. B.M. iii. 75, 1855(♀).

Dimorphoptera unicolor Sm., Trans.Ent.Soc.Lond.1868,238(♀).

Cosila minuta Sauss., Grandidier, Hist. Madagascar, xx. 233, 1892(♀).

Hab.—S. Australia(Saussure).

17. A. LÆVIFRONS Sm.

Dimorphoptera lævifrons Sm., Descr. n.sp. Hym. p.188, 1879(♀).

Myzine levifrons D.T., Cat. Hym. viii. 124, 1897(♀).

Hab.—Victoria (French); South Australia (Smith).

18. A. COGNATA Sm.

Dimorphoptera cognata Sm., Descr. n.sp. Hym. 188, 1879(♀).

Myzine cognata D.T., Cat. Hym. viii. 122, 1897(♀).

Hab.—Swan River, W.A.(Smith).

19. A. FASTUOSA Sm.

Dimorphoptera fastuosa Sm., Trans. Ent. Soc. Lond. 1868, p.240(♀).

Myzine fastuosa D.T., Cat. Hym. viii. 123, 1897(♀).

Hab.—Champion Bay, W.A.

20. A. CLYPEATA Sm.

Dimorphoptera clypeata Sm., Trans. Ent. Soc. Lond. 186 p. 240(♀).

Myzine clypeata D.T., Cat. Hym. viii. 122, 1897(♀).

Hab.—Champion Bay, W.A.

The second recurrent nervure is received close to the apex the second cubital cell.

21. A. ARGENTEO-CINCTA Gribodo.

Cosila argenteo-cincta Gribodo, Ann. Mus. Civ. di Storia Na Genova, xviii. 261, 1883(♀).

I have not seen this species, which seems to differ from *anthracina* Sm., in the neuration, also by the presence of tubercle at the base of the first ventral segment of the abdome and the sparser puncturation of the whole insect. Length 15 mm

Hab.—Australia.

Described by Gribodo from a specimen in his own collection.

THE GEOLOGY OF NEWBRIDGE, NEAR BATHURST, N.S.W.

By W. N. Benson, Student at the University of Sydney.

(Plates xxii.-xxiii.)

i.—Introduction and Previous Literature.

The village of Newbridge is on the Great Western Railway, 20 miles south-west of Bathurst, and 165 from Sydney. It is the outlet of the mines of the Trunkey and Tuena districts, and may become that of the Rockley and Burraga districts. The country described in this paper includes the Parish of Galbraith, in which Newbridge is situated, and the southern portion of the adjoining Parish of Lowry, in which most of the marble occurs; references are also made to the Caloola gold mines, and the copper mines of Belmore and Cow Flat, which are in the Parish of Ponsonby, still further to the east. The country is hilly but not very rough, and is drained by Reedy Creek, George's Plains Creek, and Queen Charlotte Vale into the Macquarie River.

Five series of rocks are developed in this district:—slates, limestones, chlorite-schist, andesites, and granites; and the mode of occurrence and the description of the varieties of each of these form the subject matter of this paper.

Very little mention has been made of Newbridge district in scientific literature. The boundaries of its several formations are

shown rather incorrectly on the Rev. W. B. Clarke's map, a his boundaries are followed in the Geological Survey Map of 18 Scattered references occur in the Reports of the Department Mines.* The Rev. J. Milne Curran† has drawn attention to t exposure of the junction of granite and slate in the railw cutting near Newbridge, and has sketched the branching of granite vein. He has also referred to the diabase‡ at Blayne an augite-plagioclase-magnetite rock, probably connected with t andesites of this region. Mr. W. J. Clunies Ross, B.Sc., h sketched very approximately the boundary of granite and sla in this district, and has made several observations on the slate Mr. J. E. Carne has reported on the iron ore deposits,|| and h report is quoted by Mr. Jaquet,¶ who also settled the relation andesites to slates in the neighbouring district of Cadia.** M L. F. Harper reported on the Caloola marbles in 1904.†† Mr.

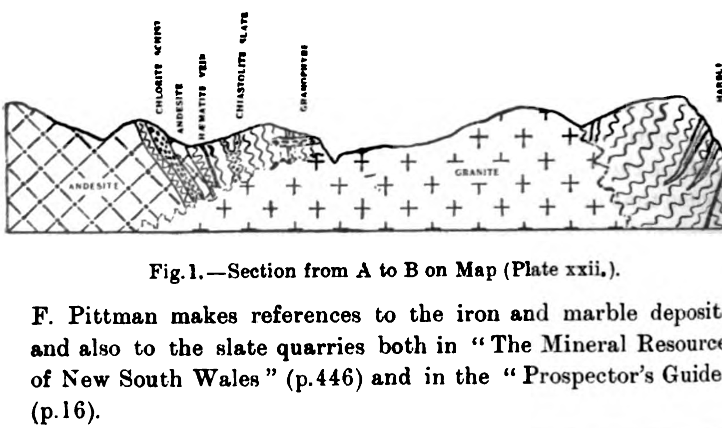

Fig. 1.—Section from A to B on Map (Plate xxii.).

F. Pittman makes references to the iron and marble deposit and also to the slate quarries both in "The Mineral Resourc of New South Wales" (p.446) and in the "Prospector's Guide (p.16).

* See list given by Curran in these Proceedings for 1891, (2) vii. pp.175-17

† *Op. cit.* p.203.

‡ *Op. cit.* p.231.

§ Q.J.G.S. 1894, p.105, *et seqq.*

|| Ann. Rept. Dept. Mines New South Wales for 1892, p.150.

¶ Mem. Geol. Surv. N. S. Wales, Geology. No.2. "The Iron Ore Deposit of New South Wales," p.137(1901).

** *Op. oit.* pp.21-30.

†† Ann. Rept. Dept. Mines N. S. Wales, 1904, p.147.

So far as I know, this is the whole of the work that has been done on the Newbridge district; and no detailed description or map of the formations as a whole has yet appeared.

ii.—The Andesites and Asbestos.

The south-western portion of the Parish of Galbraith is andesite. At its contact with the slate it becomes laminated and very decomposed, so that the distinction between decomposed slate and decomposed andesite is often difficult. It is, therefore, not quite certain whether the andesites are intrusive into or interbedded with the slates. I have not noticed branching andesite veins, as might be expected in an intrusion; and there are frequent examples of long, narrow bands of slate among the andesite. These Newbridge andesites appear to be continuous with those of Cadia, and their microscopical characters are similar. The Cadia andesites are stated by Mr. J. B. Jaquet to be interbedded with the slates.* I, therefore, am inclined to believe that the slates are interbedded with the andesites, that is, the andesites formed a series of contemporary flows. In the absence of any fossils in the adjacent slates, we cannot say whether the slates are Silurian or Ordovician. Mr. Jaquet classes those of Cadia as Ordovician.

The boundary of the andesites crosses the Trunkey Road near the southern limit of the Parish. It runs from there up to the point where the railway crosses Reedy Creek. Thence it runs in a north-westerly direction for about three miles, beyond which it was not traced. The rock outcrops fairly well near the boundary, but away from it the outcrops are few. The rock-mass as a whole must be fairly porous. A strong spring of pure water runs (September) at the top of Smith's Hill.

An exact petrographical description of the Smith's Hill andesite is as follows:—

Macroscopical.—Hard, compact, light green rock, with pyroxene and felspar phenocrysts.

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* "Iron Ore Deposits of New South Wales," 1901, p.21.

Microscopically, it is seen that the rock was originally made of augite and felspar phenocrysts, with subordinate ilmenite, s in a felspathic ground-mass. Subsequent alteration has chang all the ilmenite into leucoxene, and the felspathic base has becon partly epidote and sericite. The phenocrysts of felspar are st determinable by their extinction angles, and are andesine. Th augites are beginning to be converted into epidote and chlorit the action commencing at the border, and leaving the centre the crystals unaltered. They are frequently twinned parallel 010, and occasionally diagonally. Radiate aggregates of chlorit in green and brown spherulites also occur. There are a fe crystals of pyrites, but iron ores are very subordinate. A micr photograph of this rock is shown on Plate xxiii., fig. 1.

The andesites developed here are a portion of a large area intermediate rocks, which runs west to Blayney. In it sever important mines are situated, notably those of Cadia. Two ro descriptions by Mr. Card* show the similarity of rocks of th district with those of Newbridge.

(*a*) Annadale Copper Mine, Blayney.—"These are augit andesites in different stages of alteration, the alteration takin the form of a development of epidote and to some extent chlorite (*b*) Mt. Sugarloaf.—"These are andesites, showing a developme of epidote, and containing hornblende. I am of the opinion th the hornblende is very probably of secondary origin, resultin from the paramorphic change of the augite. The augite in th specimen is distinctly uralitic."

The andesites of the Canoblas are not a portion of this are but are of a much later age.

In the south-western portion of the Parish, and in or nea Portion 17, there is an occurrence of asbestos. It is in vein about half an inch wide, running through decomposed andesit The fibres are short, rarely three inches long, and rather brittl The asbestos is quite anhydrous, and has the optical properties tremolite. It is probable that it has been formed from the augit of the andesite by uralitisation and solution.

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* Rec. Geol. Survey N. S. Wales, iv., p.159.

Besides the locality mentioned above, it occurs in Portion 5. Here the rock is less decomposed, and the fibres are not separable.

iii.—The Granites, Granophyres, and Aplites.

The main mass of the granite in this district lies in the north-eastern portion of the Parish of Galbraith, and north and north-western portions of the Parish of Lowry, though its boundaries in the latter Parish have not yet been mapped. In the preparation of this paper, little work was done on the granites of the main mass; and the rocks here described are almost entirely from the innumerable granitic veins that intrude the slate. Before passing to their particular description, I may remark that the granites of the main mass are much decomposed, and show few good outcrops except at or near their junction with the slates. They appear to be much intersected by aplite veins, which, decomposing, are very like red sandstone in appearance. I learn from Mr. T. C. Dwyer, B.Sc., that around Wimbledon, to the extreme north-east of Galbraith, coarse pegmatite is abundant. Near the boundary of the massif basic segregations are very common; the rock in which they are situated is generally a fairly coarse-grained (2-4 mm.) hornblende granite, with large orthoclase phenocrysts. The segregations are usually spheroidal. A particular description of one is as under :—

Macroscopical.—Fine-grained, dark blue granite.

Microscopical.—Hypidiomorphic granular, with predominate oligoclase, and subordinate microcline, orthoclase, and quartz. Small phenocrysts of these last three occur, and larger ones of oligoclase. The coloured minerals are hornblende, green and twinned, with brown biotite much less abundant. Magnetite also is present. Sphene occurs in brown, pleochroic crystals, passing into leucoxene. Apatite needles are frequent.

Coming now to the granitic veins, these seem to run in a general north and south direction, but branch a good deal. Two of these (the westernmost that cross the railway) were traced as far as possible, as shown on the map (Plate xxii.). They did not pass either into pegmatites or quartz veins. Curran gives sketches

of several other veins so traced.* It is noticeable in the railw
cuttings that generally the granite veins follow the cleavage
the slate, and have straight and parallel bounding walls of sla
But this rule is by no means universal, for many irregular int
sions are to be seen, and even horizontal veins occur. We m
divide the veins into three classes, (a) granitic, (b) granophyr
and (c) aplitic.

(a) *Granitic Veins.*—These are the most abundant of the vei
that cross the railway cuttings. Many of them are very high
decomposed. Some are only partly decomposed, and may st
be examined microscopically. Such an one occurs at the 16
mile peg on the new li
It intrudes the slate ve
strongly, as may be se
from fig. 2, which is fr
a sketch taken in the
railway cutting near
In Plate xxiii., fig. 3,
microphotograph of t
junction of the mi
schist with the granite
shown. Microscopica
the granite is seen to
composed of predomina
orthoclase, with oli
clase, quartz, bioti
muscovite, and apatite

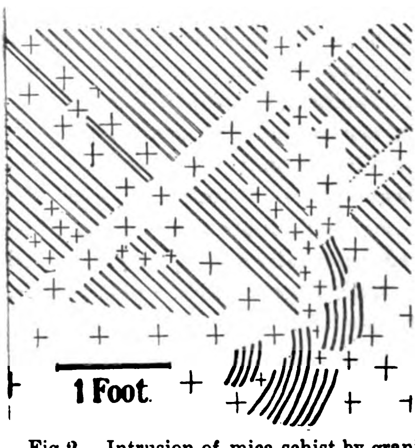

Fig. 2.—Intrusion of mica schist by granite. Sketch in the railway cutting.

In the Railway reserve and near to the boundary fence
Portion 65, Parish of Galbraith, there is a large vein of a beautif
fresh hornblende-granite. Its exact description is :—

Macroscopical.—Medium-sized grain (1 mm.) showing qua
and felspar, with abundant short prisms of hornblende, so
biotite, and occasionally pyrites.

* These Proceedings, 1891, (2) vii.

Microscopical.—Fabric hypidiomorphic granular. The minerals composing the rock arranged in descending order of abundance are :—quartz in fairly large grains with inclusions of apatite. Plagioclase, in large and small crystals, fairly idiomorphic, and sometimes zoned, probably oligoclase. Orthoclase in rather large, slightly decomposed crystals, fairly idiomorphic; twinning is infrequent. Hornblende in green pleochroic and idiomorphic prisms, occasionally twinned; characteristic six-sided basal sections occur. Biotite in large brown pleochroic flakes, frequently intergrown with the hornblende; in one instance a biotite flake appears in the centre of a perfect basal section of hornblende. Sphene in brown to red-yellow pleochroic grains, often approximating to the idiomorphic lozenge-form. Magnetite in cubes and irregular grains. Apatite and zircon.

Besides these granites, there are other rocks more satisfactorily referable to the granite-porphyries. Such a rock is that in a vein crossing the railway at the 162-mile peg. The vein is decomposed, and contains large, spheroidal boulders, segregations of a pink granite of the following description :—

Macroscopically coarse-grained, with quartz, pinkish felspar, and hexagonal biotites, easily recognisable. Large orthoclase phenocrysts are present.

Microscopically, the fabric is microporphyritic, showing the above minerals, and also twinned and zoned oligoclase and microcline. The biotite is very subordinate and is passing into chlorite; apatite occurs.

Another, and perhaps a more typical granite-porphyry, is that which forms the boulders marking the outcrop of the largest granite vein shown on the map (Plate xxii.); it is near the 164¾-mile peg, and is about 70 yards wide, and half a mile long; and forks at the southern extremity. The main mass of the vein is decomposed, the fresh boulders only being capable of sectioning. The precise description of the rock is :—

Macroscopical.—Fine- to medium-grained brownish granite, showing quartz, felspar and biotite.

Microscopical.—Fabric microporphyritic. Ground-mass: qua and orthoclase in a fine granular base, with no sign of gra phyric intergrowth. Phenocrysts: predominant oligoclase, alm idiomorphic and slightly decomposed; untwinned orthocl crystals; quartz with shadowy extinction. and strongly pleochr biotite occur, the last changing into chlorite. Muscovite present, but appears to be due merely to the decomposition the felspars.

(b) *Granophyric Veins.*—There are several rocks present in t district which may be classed as granophyres. One of th immediately adjoins the granite-porphyry last described. It a has been traced as far as possible; it crosses the railway ab 100 yards east of the 164¾-mile peg, and is about two ya thick. It bends round to the N.W., and runs about a quar of a mile before it is lost to sight.

Macroscopically it is a fine, even-grained, (0·5 to 1 mm.) ha bluish rock in which only quartz and felspar are recognisable.

Microscopically it is seen to be composed of plagioclase, ort clase, and subordinate quartz. Biotite is present in sm greenish flakes, and muscovite also, the latter being deri from the decomposition of the felspar. The plagioclase is p dominant in fairly idiomorphic crystals, probably oligocla though the twinning is not very distinct. The orthoclase idiomorphic, and generally twinned. The quartz is usually v irregular in shape, but in one or two instances shows an hexago section, with included biotite fibres placed parallel to the pri faces. The ground-mass is almost entirely quartz and orthocl in a very fine micrographophyric intergrowth generally arran radiating from some crystal, not a mica, as centre; that is pseudospherulitic structure. Apatite is an accessory mine and there is a little magnetite.

In another specimen from the same vein, however, the gra phyric structure is almost entirely absent, its place being tak by a fine-grained mixture of quartz and orthoclase, like "panidiomorphic" structure of aplites. Also in this specim the twinning of the plagioclase phenocrysts is more distin

following both the Albite and Carlsbad laws. Zoning is common in felspars, and chloritisation has just started among the biotites. This latter specimen would be more correctly classed as a microgranite. The former is a true granophyre.*

The second occurrence of granophyres is in the railway line near the 163¼-mile peg. It is in the form of a long, nearly horizontal vein of which about 80 yards are exposed in the cutting. Should it be carefully traced, I believe it will be found to extend for some distance, as specimens of a macroscopically very similar rock occur nearly one mile to the south at George's Plains Creek. It intrudes the slate very strongly, as may be seen in Plate xxiii., fig.4. A precise description of the rock is:—

Macroscopical.—Fine-grained base, with small phenocrysts of quartz and hexagonal biotite, and very large crystals of orthoclase an inch or more long.

Microscopical.—Large crystals of plagioclase almost idiomorphic, and small allotriomorphic phenocrysts of orthoclase, both with dusty inclusions; irregular grains of quartz also occur.

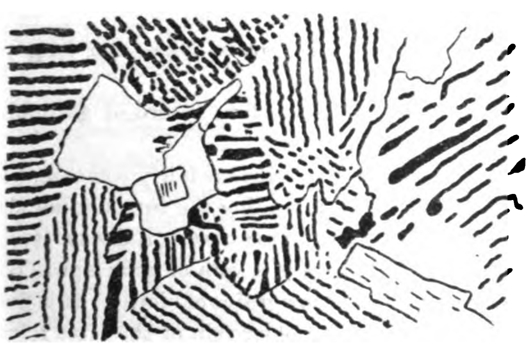

Fig.3.—Intergrowth of quartz (black) and felspar showing Baveno twinning. Highly magnified.

There is in my section one grey, hexagonal, isotropic section of garnet. Small flakes of mica and grains of magnetite are present also. In between all these crystals is a base of "panidiomorphic"

* Teall, British Petrography, p.292.

quartz and felspar, fine-grained, also a little muscovite; and the[r]
are large patches of intergrowth with a net-like structure [o]
quartz and orthoclase, rarely pseudospherulitic, but frequent[ly]
arranged perpendicular to the sides of a square, that is divide[d]
into four diagonally. Fig.3 is a sketch of such an intergrowt[h].
This appears due to the Baveno twinning of the felspar crysta[ls]
with which the quartz is intergrown, as suggested to me by D[r.]
Woolnough. Other examples occur in which the quartz crysta[ls]
are arranged like the barbs of a feather. This is perhaps referab[le]
to Carlsbad twinning of the enclosing felspar.

The most remarkable of the granophyres that I have seen [in]
this district is that which occurs in a vein 30 feet wide, crossi[ng]
the railway line at the 162¾-mile peg. Macroscopically it is [a]
hard, white, apparently felsitic rock, with thin flakes of bioti[te].
Microscopically (see Plate xxiii., fig.2) it is almost entirely orth[o-]
clase, containing every variety of graphic intergrowth of quar[tz]
from the development of very small pear-shaped quartz grai[ns]
forming long strings, up to large fishhook-like patches of quar[tz]
imbedded in orthoclase. Quartz also occurs in phenocryst[s].
There is a little muscovite in square flakes, and long pleochr[oic]
strips of biotite.

It is believed that this is the first record of granophyre fro[m]
the neighbourhood of Bathurst.

(c) *Aplitic Veins.*—Aplitic veins are fairly common, both in t[he]
granites of the massif and intruding the surrounding slates. [In]
the slate near the George's Plains Creek (Railway Reserve ne[ar]
Portion 65, Galbraith) there is a vein of pink aplite containi[ng]
quartz and felspar, with but few grains of biotite. It is fine-grain[ed]
(1mm.). It cuts through an older vein of the same mineral co[m-]
position, but of much coarser grain (5 to 10 mm.). The felsp[ar]
seems to be mostly orthoclase. This association of a fine-grain[ed]
aplite vein cutting a coarse-grained aplite vein also occurs on t[he]
Wimburndale Creek, at the point where the Peel Road cross[es]
it, some nine miles north of Bathurst. The finer-grained roc[k]
there is almost identical with the Newbridge aplite above. It [is]
composed of predominant orthoclase, with oligoclase and micr[o-]

cline, and also quartz in irregular grains. There is a little granophyric and pseudospherulitic intergrowth of quartz with orthoclase. Very subordinate biotite occurs, and some apatite.

Age of the Granites.—From the evidence obtainable in the district here described, we cannot fix the age of the granites more definitely than post-Silurian. From their examination of the whole Bathurst district, both Ross and Curran believe that it is probable that the granites are the result of two intrusions, the first pre-Devonian, the second post-Devonian.

iv.—Chlorite Schist.

The chlorite schist occurs, as before noted, in a wide band, one-quarter of a mile west of the Newbridge Railway Station. It runs in a northerly direction, crossing the present railway cutting, appearing again in the old railway cutting; and fragments of the schist are enclosed in a quartz vein about half a mile west of the slate quarry on Reedy Creek. It is so soft that it does not form an outcrop, and so can be examined in the railway cutting only.

Macroscopical.—Green and yellow striped, fibrous, splintery, highly cleaved in three directions, falling into acute rhombohedra, translucent and wax-like to the touch.

Microscopical.—Composed of talc in white, strongly birefringent fibres, running through and occasionally forming subradiating bunches in a predominant ground-mass of green· pleochroic chlorite of very low, double refraction

With a magnification of 400 diameters numerous aggregates of brown rutile needles are to be seen, and also some zircons.

Until a more extensive examination has been made in the field and laboratory, I can offer no explanation of the origin of this peculiar rock.

v.—Slates.

The slates of this district lie in a wide band, running in a S.W. direction across Galbraith Parish, between the andesites and granites, by the latter of which they have been intruded. They are the oldest rocks exposed in the district. In age they are

probably Silurian, the only fossil recognisable being a Pentameru found in the interbedded limestones; but it is quite possibl that much of the slate is Ordivician,* though so far I have seen no sign of graptolites. As to whether they are highly contorted or not, I have little evidence. Slaty cleavage is developed t such an extent that all sign of the original stratification is lost The strike of the cleavage is very variable, ranging from N.N.W to N.N.E., and the dip east or west at 50° to 90°. From examination of the Caloola limestones, I believe the true strati fication strike to be N.N.E. and S.S.W. Should the andesite be interbedded with the slates and not intrusive into them, w should be able to use their junction with the slates to give u the true dip and strike; and by this test it would seem that, a the junction, the dip was to the east at 70°, but that the strat were rather contorted; though as previously pointed out the dis tinction between decomposed andesites and decomposed slate i rarely clear at their junction.

In this region the slates contain fissure-veins filled with iron ore (detailed later), and in one place indications of a copper lode and are netted with many quartz veins. One of these veins is s notable as to merit description. It is first seen capping a smal rise by the road-side in Portion 10, Parish of Galbraith, though it does not occur in the road-cutting below, where there is a wide band of soft pipeclay which represents the slate out of which the silica was bleached to make this great vein. The leaching out o the silica was also accompanied by a removal of the iron, for the pipeclay is nearly white, and the iron is segregated in a vein o siliceous hæmatite near by. The quartz capping the hill i almost pure. As we pass to the north-west, we cross a smal valley where there is no sign of the reef. It occurs again on the top of the next hill (Portion 35) among the andesites, and forms a great scarp or wall running down the hillside. It does not occur in Reedy Creek, but forms a large patch (not marked on the map) on the flank of Smith's Hill opposite. Hence the vein forms what may be called a horizontal pipe vein.

* J. B. Jaquet, "Iron Ore Deposits of New South Wales," p.20.

Sufficient field-work has not been done to ascertain whether the quartz veins are continuations of granitic veins; the two granite veins traced do not pass into pegmatite or quartz. This point appears to be well worth investigating in view of the differences of opinion that exist as to the origin of pegmatites. Also, were the quartz veins shown to be connected with the granitic intrusion, it would completely settle the question as to the relative ages of andesite and granite.

At the Caloola Gold Mine there is in the slate a large fissure some 30 feet across, and extending probably to a great depth. This is filled up with soft mud in which are embedded rounded, and apparently waterworn, pebbles of various rocks, some rather similar to the Devonian quartzites. It seems probable that this is a fault crush-conglomerate.

Also at Caloola is the curious feature of a highly crumpled slate lying between walls of quite straight laminated rock. The dip and strike of the slate varies greatly within a hundred yards of the mine, but broadly it may be said to be easterly at 45°.

To describe these slates petrographically, they can be divided into seven distinct groups with varieties, each of which has a sufficiently characteristic appearance in hand-specimen to distinguish its members; and also each group or variety possesses an almost constant microscopic character. Each group may be described in order, dealing with its petrography and distribution in the field; and an attempt will be made to show the origin of each kind of slate. The seven groups are:—

Blue Slate (varieties, Green Slate and Oxidised Slate), Quartz Schist, Augen Slate, Felspathic Slate, Knotted Slate (variety, Spotted Slate), Chiastolite Slate, and Mica Schist.

i. *Blue Slate.*—Macroscopic characters: hard, fissile, blue, fine-grained; thin flakes have a translucent green colour and semi-lustrous waxy appearance. Some specimens have small cubes of pyrites developed. In the field this rock goes in a narrowing band southwards. It forms the whole hill in which the slate quarry (on Portion 42, Parish Galbraith) is situated, and runs down along Back Creek nearly to Newbridge. It also goes north

of Reedy Creek towards the Dry Diggings for some distance (se
Map of the Distribution of the Slates, fig.4).

Microscopically, it is very fine-grained, consisting chiefly c
quartz, some of which shows strain-structure. It is generally al
of one size, though certain bands of coarser grain run throug

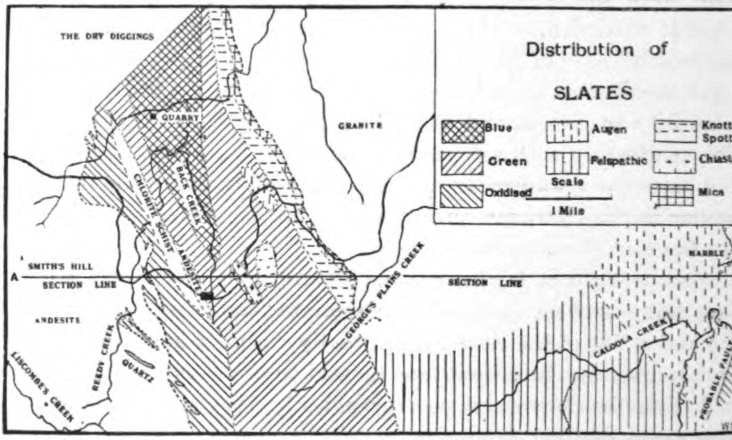

Fig.4.—Sketch map showing the distribution of the various kinds of slate

the rock. Some of the quartzes contain liquid inclusions. Th
effects of rock-flowage, as described by Van Hise,* are frequentl
very marked. Biotite runs through the slide, segregated int
bands which are nearly parallel, the direction being that of th
cleavage of the slate. Some of the bands are wavy, in whicl
case the quartz grains on the convex side are smaller than thos
on the concave. The biotite is generally brown, highly pleochroic
and birefringent, though the process of chloritisation, which ha
just started, renders these properties less marked. The biotite
crystals are oriented parallel to the slaty cleavage. In the band
of biotite there is also a little carbonaceous matter, and probably
some magnetite. A few grains of andalusite occur, which are

* " Treatise on Metamorphism." Monograph xlvii. U. S. Geol. Surv.
Chap. viii., p.748.

recognisable by their high refractive index and low double refraction. Tourmaline also occurs, but is not abundant; scarcely a dozen crystals are present in the type-slide, though other members of the group are richer in this mineral. The crystals are oriented quite without reference to the cleavage plane. In some members of this group a little orthoclase appears to be present. The usual accessory minerals are rutile in fairly short crystals, zircon, and apatite in very small prisms.

Mr. H. J. Meldrum, B.Sc., has analysed the slate in the quarry on Portion 42, a very typical example of this group of slates. He obtained the following figures (A).

	(A)	(B)
SiO_2	68·67	64·77
Al_2O_3	16·99	14·45
Fe_2O_3	1·11	1·84
FeO	1·87	4·54
MgO	2·34	2·34
CaO	2·33	2·33
Na_2O	1·07	1·57
K_2O	2·88	5·03
TiO_2	present n.d.	0·60
H_2O	1·92	1·92
	99·18	99·39*

Analysis B, showing the composition of a biotite slate from Cross River, Minnesota, U.S.A., is added for comparison. It will be seen that the analyses are very similar, the Newbridge slate being richer in silica but poorer in alkalies than the other.

This is the normal slate of the district, being simply the original sediment consolidated. All the other types of slate, except the Augen and Felspathic, may be regarded as metamorphosed Blue Slate.

The varieties of this first group are Green Slate and Oxidised Slate. The former is partly oxidised Blue Slate, and is perhaps the most common slate of the whole area. As will be seen on the map (fig.4), it occurs between Newbridge Station and the

* Rosenbusch, Elemente der Gesteinlehre, p.513.

first great bend in the railway line, where it passes into Auge
and Knotted Slates. It also occurs between the slate quarry an
the andesites.

Macroscopically, very fine-grained, soft, light grey-green, wit
good slaty cleavage and lustre. A little limonite is frequentl
present in the cracks.

Microscopically, almost identical with the Blue Slates; th
disposition and size of the quartzes is the same, and also of th
biotite crystals. The chemical change is chiefly in the biotite
which has been largely altered to sericite, with the formation o
hæmatite and some chlorite. The accessories, tourmaline, anda
lusite, rutile, zircon, and carbonaceous matter, are present, th
last being a widely varying quantity even in slates of the sam
variety, since probably it was a varying quantity in the origina
silt from which the slates were formed. Certain members of thi
variety have special characteristics; one specimen contains a fe
grains of oligoclase, another a great quantity of finely divide
andalusite.

In this subgroup is classed the slate from the Caloola lime
stones, though it differs from the type in several particulars. I
is to be regretted that the specimen was not obtained *in sit*
but only from the quarry débris. In hand-specimen it is of
bright apple-green, rather coarser in grain than most members o
this group, slightly lustrous, and with a rather poor cleavage
Microscopically it is chiefly quartz, showing the effects of rock
flowage. Coloured minerals are less common than usual; th
biotite has been almost completely chloritised, forming feebl
pleochroic flakes of low double refraction. A little actinolit
occurs, and some muscovite; but there is little or no hæmatite
Tourmalines are frequent in grey-blue, pleochroic prisms; rutil
abundant in comparatively large yellow or brown needles, an
andalusite common in well developed, colourless, highly refractin
prisms with pyramidal, terminal faces. Zircons occur in th
quartz grains.

The second variety of this group, Oxidised Slate, is ver
abundant. It forms a band running down the eastern boundar

of the andesites, and extends from there to the Green Slate zone (fig.4). It is also developed at the Caloola Gold Mine on the east side of the creek, and has been here brought into contact with the Augen Slates. This, I believe, is due to the existence of a fault as suggested previously (p.535).

The Oxidised Slate is the final product of the oxidation of the Blue Slate. At Caloola this zone of oxidation extends down below the level of the creek-bed. In hand-specimen it is crumbly, soft and silky to the touch, and yellowed with limonite. Frequently it is recemented near quartz veins, and forms a hard rock. At Caloola it contains large limonite pseudomorphs after pyrites, usually in cubes, but occasionally dodecahedra; on the andesite boundary it is coloured a deep red with hæmatite derived from the andesites.* At this latter point it is soft and friable to a depth of 40 feet, and has lost cleavage and stratification.

The second group is termed Quartz Schist, and there is but one occurrence known to me. It is at Caloola, where it forms the wall of the fault before described. In hand-specimen it is a hard, lustrous, pink and white streaked slate, like shot silk, with a fair cleavage and very fine grain. Microscopically it is almost entirely quartz in very fine grains, cemented by films of haematite and limonite. Sericite occurs in long parallel fibres, and some rutile. Zircons are included in the quartz grains. Rock-flowage structure is not well developed.

From the field-occurrence as well as from the appearance of this rock, I am inclined to believe it is a rather sandy slate which has been crushed during the faulting.

The third group is termed Augen Slate, a name suggested to me by Dr. Woolnough. It occurs typically near the limestones of Caloola, where it forms a broad band running approximately north and south; it also occurs in the hill between Newbridge and the granites crossing the railway in a band 50-60 yards wide, running

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* J. B. Jaquet, "Iron Ore Deposits of New South Wales," p.26.

in a northerly direction. In hand-specimen this rock is n
unlike the green slates, though greyer and more fibrous; and
cleavage is poor. Its distinguishing feature is the presence
numerous blebs of clear quartz up to one-eighth of an inch
diameter. These grains are nearly round or lenticular, but ha
rough surfaces and are not smooth as if waterworn. Mic
scopically it is very like the green slate, and shows the ro
flowage structure slightly developed among the small quartz
and parallel disposition of the biotite, which is partly chloritis
with the formation, in some cases, of hæmatite. Sericite occu
and comparatively large crystals of a twinned plagioclase, p
bably oligoclase, which contain inclusions of biotite and seric
arranged in lines parallel to the general direction of schistosi
In another specimen of Augen Slate the felspar appears to
albite. Pyrites occurs in some instances, rutile and zircon usual
Tourmaline is rare or absent. Muscovite is sometimes prese
usually inclined to the direction of schistosity. The quartz ble
may be either of one optically continuous grain, or of seve
grains of different orientation. The lines of biotites may
truncated by the quartz blebs, or may bend round them, or mo
rarely pass into them. The boundary of each quartz bleb is n
a smooth curve, but irregular.

With regard to the mode of origin of the Augen Slat
Curran* terms them conglomerates, and points out that, as t
limestones, representing coral-reefs in the old Silurian sea, we
doubtless near the shore-line, the Augen Slates, which a
generally in the neighbourhood of the limestones, will represe
the beach-conglomerates. While this may in part account f
the large quartz grains, I am inclined to believe that they a
chiefly due to shattering and subsequent recrystallisation und
pressure. The larger quartz grains would resist the crushi
more than the other grains, or would be broken up only on the
surfaces; and during the recrystallisation the large grains wou
grow at the expense of the smaller. The surface of the blebs

* These Proceedings, 1891 (2), Vol. vii. p.198.

so penetrated by the grains of other minerals, particularly biotite, that it cannot be supposed to be a waterworn surface.

The fourth group is that of the Felspathic Slates. This is perhaps the most interesting of all the groups. They form a large portion of the southern part of the Parish of Lowry, stretching from its western boundary to near the Caloola quarries; they also occur in a rather unusual form at a point where George's Plains Creek passes from the slates to the granites. Macroscopically, the Felspathic Slates are hard, compact, dark-coloured rocks of rather coarse grain (*i.e.*, the individual grains can be separated by the naked eye), and with poor or bad cleavage, though the parallel arrangement of particles is obvious Microscopically, they are not unlike the augen slates, showing a granular ground-mass and some comparatively large grains of quartz, with indications of a rock-flowage structure. Biotite is in plenty in green-brown flakes, and muscovite is in smaller flakes. The usual accessory minerals, rutile, zircon, and sometimes magnetite occur; also a good deal of andalusite. Orthoclase and oligoclase are developed in large idiomorphic and abundant crystals, twinned in their usual fashion, and very full of inclusions frequently arranged in bands parallel to the direction of schistosity, and irrespective of the orientation of the felspar crystal.

The unusual variety from the creek is characterised by its very typical rock-flowage structure, and the abundance of large oval masses of orthoclase containing oval inclusions of quartz arranged parallel to the schistosity. Muscovite and magnetite occur. Albite is also present, but subordinate to the orthoclase. Further, long ropy bands of very fine, almost ultra-microscopic, colourless needles go through the rock in the direction of schistosity, but bending in and out among the larger grains. These needles would be called sillimanite were it not that they are not fractured, and are sometimes even bent. They may be tremolite.

As to the origin of these slates, the structure is so unlike that of an ordinary slate that we can hardly believe them to be merely altered sediment. It seems more probable that they were originally tuffaceous sediments of a rather acid type; subsequent

pressure has fractured the larger crystals, and recrystallisatio has to some extent induced a flowage-structure, especially marke by the biotites, though the flowage-structure is in most specimen quite subordinate to the cataclastic structure.

The fifth group is that of the Knotted Slates. Their chie occurrence is in the railway cutting, between the augen slat band and the granite massif. They are fine-grained, grey, wit a silky lustre and good cleavage. On cleaving, the flake will b seen to contain dents or lumps up to the size of a grain of whea and, if we polish the flake, the lumps will be found to have black core. I have not sectioned a specimen of this slate from Newbridge, but an exactly similar rock occurs at the Wimburn dale Creek, as is described by Curran;* and sections of it sho the following characteristics—the predominant mineral is quart showing rock-flowage. Brown biotite is very abundant, an runs in strings parallel to the schistosity; it is not very pleochroi Carbonaceous matter is very abundant, and finely divided Some tourmaline occurs, and small rutiles, both well crystallised The black spots are aggregates of carbonaceous matter with som magnetite. In one instance the boundary of a spot is almos pure graphite, outside of which the biotites are arranged circum ferentially, so that a wave of extension passes round the spot a the slide is rotated between crossed nicols. Generally the spo is elliptical, but this instance is in the form of a prism wit terminal pyramidal faces. Inside the black border there i carbonaceous matter intimately mixed with green and brow biotite. These spots probably represented incipient andalusit or chiastolite crystals.

The second member of this group, Spotted Slate, is only th oxidised outcrop of the Knotted Slates. It occurs in a ban running down the eastern side of the hill between Newbridg and the granites, that is a band parallel and near to the junctio of slate and granite. This band is about 200 yards wide. In hand-specimen it is medium to fine-grained, soft and reddish

* These Proceedings, 1891 (2), Vol. vii., p.201.

cleaves fairly well, showing a few glittering mica flakes on cleavage. The spots in it are quite black, and generally elliptical; and contain a good deal of mica. Microscopically, it differs from the knotted slates in that there is less carbonaceous matter; the biotites are chloritised and stained yellow with limonite; and muscovite occurs in large flakes lying across the general direction of schistosity. Small oxidising grains of magnetite occur; tourmaline and rutile as before.

Sixth Group: Chiastolite Slates.—These have so far been found only in the railway cutting just east of the large western granite vein, and about 200 yards east of the 164¾-mile peg. The specimens obtainable in the old railway cutting are better than those in the new. The slate appears first about two yards from the granite vein, and extends to 20 or 30 yards from it, the crystals becoming smaller as we pass outwards. In hand-specimen it is rather like the green slate, and has a fairly good cleavage. There are dark green rectangular prisms in it up to one-quarter of an inch in length, and surrounded by a bleached halo (Plate xxiii., figs.5, 6). Sometimes instead of the prism-form the black patches are in the shape of crosses, and may be with or without definite outline. Microscopically, the green main portion of the slate is seen to be very fine-grained, with rather larger crystals of biotite than usual, which are strongly pleochroic; though sometimes they may be partly chloritised. Sericite is scattered in wisps over the slide; there are some flakes of muscovite and a little magnetite. Rutile and tourmaline occur in their usual forms. Some andalusite is present as irregular grains. The bleached halos of the dark patches are composed of quartz, sericite, and muscovite only. The dark patches consist of a closely felted aggregate of biotite, muscovite, and a little quartz. I believe them to be decomposed chiastolite crystals.

The seventh group is that of the Mica Schists. These are the most metamorphosed of all the slates that occur in the district, and vary considerably in hand-specimen. Sometimes they are only distinguishable from the green slates by their coarser grain, and large flakes of muscovite. In this form they are generally very

soft and decomposed. The band of mica schist that lies between the chiastolite slates and the granite vein is of this type. A second and more common type is seen among the granite veins nearer the massif. It has a very fair cleavage, and on the cleaved surface comparatively large flakes of mica can be seen. The mica is arranged in black layers which alternate with grey, finer-grained, less micaceous laminæ. Junction-specimens of slate and granite are easily obtained, and can with care be sectioned (see Plate xxiii., fig.3). Microscopically the slate is recognisable by its unusually large quartz grains, by the presence of fairly large orthoclases free from inclusions, the abundance and size of the muscovite flakes, and the complete absence of sericite and carbonaceous matters. Biotite occurs in bright red-brown crystals forming parallel bands which project from the slate into the granite for a short distance from the line of contact. This is probably due to the selective absorption of the schist minerals by the molten granite, the quartz being absorbed more than the biotite. The granite is devoid of coloured minerals for about one-eighth of an inch from the junction. Small rutiles occur in the slate, and some brown, pleochroic, perfect tourmaline crystals.

The schist that is in contact with the granophyre vein near the 163¼-mile peg is different from either of these types. It would be easy to mistake it in hand-specimen for a blue slate, save that it is black, and has not the same waxy translucency. Microscopically it is very highly crystalline, though of fine grain. Rock-flowage structure is typically developed. Quartz, biotite, and carbonaceous matter are the chief minerals. Large clear grains occur, with parallel rows of inclusions, and these Dr. Woolnough believes to be potential andalusites. This mica schist is very strongly intruded by the granophyre (see Plate xxiii., fig.4).

We have thus as a consequence of contact-metamorphism first, the formation of knots in the blue slates. These pass later into chiastolite crystals. By still further alteration the chiastolite slate passes into mica schist, which is the most metamor-

phosed of all the slates described. The felspathic and the augen slates cannot be regarded as products of contact-metamorphism, but rather of regional metamorphism; the sediment from which they were formed was not identical with that which has now become blue slate.

The other types of slates not mentioned above are merely the products of the weathering of the blue or knotted slates.

vi.—The Limestones.

The limestones occur in a group of lenticular beds near the Caloola gold mines, and some eight miles east of Newbridge. They were geologically examined by Mr. L. F. Harper* and economically reported on by Mr. A. L. MacCredie.† The greater part of them is leased to, and worked by, the Commonwealth Marble Quarries, Ltd. Five occurrences may be noted there, as under the number of each description referring to its position on the appended map (Plate xxiii.).

i. (Portions 104 and 115 of the Parish of Lowry). This is the seat of the main quarrying operations. The patch of limestone is about one-quarter of a mile long in a N.N.E. direction and five or six chains wide. It is composed of almost pure, white, crystalline marble; the grain-size is very even, about 1 mm. The marble is very solid, there being but few cracks or "dryers," so that large blocks are easily obtained. Along the dryers are dendrites, flakes and tufts of sericite, and occasionally crystals of chalcopyrite, galena, and actinolite, metasomatically replacing the limestone. In places the stone is completely replaced by a soft green steatite, fibres of which penetrate into the calcite grains. Microscopically, this seemingly homogeneous green mass is shown to be composed of practically colourless fibres of chlorite, recognised by its low double refraction, small optical axial angle, and optically positive character. There is also a little strongly birefringent talc or sericite, frequently in radiate groups, some

* Ann. Rept. Dept. Mines New South Wales, 1904, p.147.
† C.M.Q. Ltd., Prospectus.

corroded calcite, and many perfect rutile crystals, frequentl geniculately twinned. At the Belmore Copper Mine (Cow Flat Parish Ponsonby, and about five miles north-east of Caloola) thi replacement of calcite by chlorite is very common, and here als the silicate actually associated with the ore is actinolite, so much so that the ore appears to be in a country rock of actinolit schist, which the microscope shows to be only a limestone almos entirely replaced by the actinolite. Mr. W. J. Clunies Ross B.Sc.,* has analysed the chlorite and actinolite; he shows th chlorite to be a hydrous silicate of alumina; and, for the actino lite, he gives figures proving it to be essentially a magnesia-lim silicate with smaller amounts of iron and alumina. The analysi corresponds to a typical analysis of actinolite given by Dana.†

Seeing that, both at Caloola and at Belmore, the copper pyrite occurs with actinolite metasomatically replacing the limestone it appears probable that the one solution deposited both of thes minerals, *i.e.*, the sulphidic cupriferous solution also containe the silicate actinolite. The solution that brought up chlorit was probably connected with this same metalliferous solution The Belmore vein appears to correspond more closely to th sericitic silver-copper type of Lindgren‡ than to any other of th types he mentions.

The marbles of the Caloola quarries have been analysed by th Department of Mines with the following result:—§

$CaCO_3$	97·07 ...	84·78 ...	97·71
$MgCO_3$	1·47 ...	13·32 ...	1·75
$Fe_2O_3 + Al_2O_3$	0·10 ...	0·91 ...	0·04
Insoluble	1·45 ...	0·95 ...	0·46
	100·09	99·96	99·96

These figures show that while dolomite does not appear t occur in the marble, magnesium carbonate is present in quit

* Report of the Seventh Meeting of the Australasian Assoc. Adv. Science Sydney, 1898, p.384.

† System of Mineralogy, p.393.

‡ Genesis of Ore Deposits, p.596.

§ Ann. Rept. Dept. Mines New South Wales, 1904, p.147.

considerable quantities. This is quite in accordance with the results obtained by Prof. Skeats,* which show that up to fifteen per cent. of magnesium carbonate may be absorbed by a limestone before dolomite crystals appear. The question arises as to the cause of the presence of so much magnesium carbonate in the marble. Was it brought in by the metalliferous solutions, which were rich in magnesia; or was it introduced by replacement from sea-water while the limestone was still a coral-reef, after the manner described by Prof. Skeats? The latter I should imagine to be the case, for if the magnesia were derived from silicate solution it would probably be in accordance with an equation like the following

$$2CaCO_3 + MgSiO_3 = CaCO_3MgCO_3 + CaSiO_3$$

which would mean the formation of much wollastonite. Now, though I have seen a specimen of wollastonite said to have come from Caloola, I have not seen any *in situ*, and must hence believe it to be rare. Therefore, the reaction above could not have taken place on a large scale, and therefore the alternative origin of magnesia in the marble must have been the more important.

So far fossils have not been found in this quarry.

ii. (Portion 66, Parish Lowry). This is a narrow lens, less than three chains wide, crossing a small creek about three-quarters of a mile south of Occurrence No. i. It is a very fine-grained, good, solid marble, but its extent is not yet definitely settled. Probably it extends only a chain or two north of the creek, but may run further to the south. Major axis runs about N.N.E.

iii. (Portion 265, Parish of Ponsonby). This quarry, the first one to be worked, is situated a mile to the S.S.W. of No. i. It was originally worked for lime. The marble is of a rather finer grain than the previous occurrences, and in the exposed portions shows a pink or creamy colour. It is intersected by veins of almost colourless, coarsely crystallised calcite. Sericite and

* Bull. Mus. Comp. Zool. Harvard Coll., Vol. xlii., p.102 (1903).

chlorite occur as before, but ores are rarer. A few unmistakable traces of *Pentamerus Knightii* are to be seen on weathered surfaces. This fixes the age as Upper Silurian. Other markings occur, which may be corals but are very doubtful.

In extent this patch of limestone may be the largest of the group. To the north it is overlain by alluvium, while to the south it runs into a hill for some distance, for slate does not appear to outcrop for a long way to the south of it.

iv. (Occurs in the ∩-bend of the Caloola Creek, opposite Portions 100 and 99, Parish of Lowry). This is shown by a block of marble in the creek-bed, visible only at low water. If it is really *in situ*, it can be part only of a very small lens, for the slates appear to be *in situ* within 20 yards of it.

v. (At the northern end of Portion 99, Parish of Lowry). A small almost circular patch, about a chain across, and one-quarter of a mile south-west of the first occurrence here described. The marble is of good quality.

In none of the quarries has the junction between the slates and limestones been exposed, so that the dip of the strata here cannot, by this means, be determined yet. The strike, however, is N.N.E., as is shown by the direction of the major axes of the lenses of limestone. On the eastern side of Queen Charlotte Vale there is a series of limestone patches, some containing *Pentamerus knightii*, running approximately in this N.N.E. direction through Cow Flat, and terminating on the Mount, where they are highly dolomitised, and contain 43·73 per cent. of magnesium carbonate.* If we continue on the same direction from here across the granites of the Bathurst Plains, we again come on limestones at Fernbrook, and at Limekilns, very rich in fossil content, *Stromatopora*, *Favosites*, *Phillipsastræa* and some Pentameri.† There thus appears to have been a continuous horizon, with a N.N.E. strike, extending for 30 miles. As to its dip, there is little definite evidence. The Belmore copper lode

* W. Clunies Ross, Rept. Aust. Assoc. Adv. Sci. 1898, p.384.
† W. Clunies Ross, Q.J.G.S. 1894, p.113.

near Cow Flat has the same strike, and dips W. 20 N. at 45°. This may be the dip of the strata in that locality.

vii.—Economic Minerals.

Gold.—In the early days there was a good deal of shallow digging near Newbridge in what is now the railway reserve; but it was never very satisfactory, and has entirely ceased.* Lately, however, a mine has started in the western part of the Parish near the andesites (Portions 20 and 22), and cyanide vats are to be set up. The great quartz reef (see p.534) has been much prospected but is barren. The mine at Caloola has been worked successfully for some time, the gold occurring in a soft, highly oxidised slate.

Dredging has been carried on with some success in the valley to the north, just outside the Galbraith Parish boundary, where in the alluvium brought down by the Reedy Creek, consisting of slate, andesite, and a little granite débris, payable gold was found on the granite floor at a depth of about 25 feet. This dredge, has, however, lately closed down.

Silver.—Some silver ore was reported from here,† and a shaft was put down on Portion 29, Parish Galbraith, just near the southern end of the hæmatite veins. Nothing payable was found.

Lead has been reported from this district,‡ but I did not learn that any mining had been done for it.

Copper.—Within the district described in this paper no payable copper lodes have yet been discovered. Traces were found in the making of the new railway cutting, and a lease was pegged out, but nothing done. Mr. J. E. Carne reports a find of sulphide ore from Colo Creek,§ near Newbridge, but that is outside the area here described; nor, so far as I know, has any mining been

* Pittman, "Prospectors' Guide," p.16, 1905.

† E. F. Pittman, Min. Resources of New South Wales, p.127.

‡ Pittman, *op. cit.* p.192.

§ Geol. Surv. New South Wales. Mineral Resources No.6. "The Copper Mining Industry," &c.(1899), p.76.

done there. Copper pyrities occurs, as previously described, i the marble at Caloola. But its chief occurrence near Newbridg is at Cow Flat, where there are two lodes, worked respectivel by the Cow Flat Mine,* now closed, and the Belmore Min (Lloyd)† still working. The surface indications of both thes lodes is very distinct, being marked by hæmatite, malachite, an a little azurite. Actinolite schist, a lime-silicate rock, is th country rock, and associated are chlorite limestone and slate.

Iron.—The iron ore deposits of Newbridge, though rathe small, are of excellent quality. They were described by Mr. J E. Carne, F.G.S., in 1891.‡ The lode runs in a north-westerl direction from Portion 91 of Galbraith Parish, across Portions 10 and 108, where it is very poor, and appears again in the Railwa Reserve, and in Portion 59; it is said to have been followed som miles to the north of this. A large amount of ore has been take from the outcrop in the reserve, and a typical analysis of it i given in Mr. Carne's report (*op. cit.* p.150).

The southernmost opening on Portion 91 shows very goo specimens of hæmatite, sometimes stalactitic; but as a whole th lode here is very siliceous. The intermediate outcrops in Portion 108 and 104 are useless.

This lode is, according to Mr. Carne, "a fissure vein extendin for several miles, and locally thickening at the parts opened up There is yet no indication of its depth and whether or not i passes into pyrites at the water-level. It is still solid hæmatit at 35 feet deep. The walls of the lode are nearly vertical inclining slightly to the east."§

At Caloola in the oxidised slates that are crushed for gold there are frequent limonite pseudomorphs after perfectl crystallised pyrites, which are up to one inch across. The deepes workings of the gold mines, 50 feet, are still in the zone o oxidation.

* *Op. cit.* p.82.

† *Op. cit.* p.52.

‡ Ann. Rept. Dept. Mines New South Wales, 1892, p.150.

§ J. B. Jaquet, "Iron Ore Deposits of New South Wales," p.138 (1901).

Manganese.—At the inner end of a tunnel on either G.L. 271 or 262, Parish Ponsonby near Caloola, there is a vein three feet wide of soft crumbly, but seemingly fairly pure wad; other veins occur in the hill. Considering the low price of manganese, it appears to me very doubtful that these can be worked to any profit.*

Marble.—Large blocks can be easily obtained from the Caloola quarries. It is of excellent quality, has been used for statuary, pavements, steps, &c.†

Slate.—A quarry was opened up on Portion 42 of the Parish of Galbraith, and a good deal of stone removed; its poor fissility prevents it from being used for roofing slate. It could, however, be used for flagging, kerbstones, shelvings, &c., though rather soft.‡ It is very fine-grained, black, lustrous. The analysis of this slate was given on p.537.

Asbestos.—As described previously, this occurs in narrow veins, is short in fibre, and brittle. Also there is very little of it. It cannot therefore be of much use commercially.

Diatomaceous Earth.—An occurrence has been recorded from near Newbridge,§ but I was unable to get any information about it locally.

viii.—Summary.

In the foregoing an endeavour has been made to show in some detail the geological and petrographical features of the Newbridge district. It has been shown that the oldest rock is slate, probabably Ordovician, interbedded with contemporaneous andesite flows; and that higher in the series the slate is Silurian, as proved by the presence of *Pentamerus Knightii* in the inter-

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* Pittman, "Min. Resources of New South Wales," pp.243-4.

† *Op. cit.* p.434; also L. F. Harper, Ann. Rept. Dept. Mines New South Wales, 1904, p.147.

‡ Pittman, "Min. Resources of New South Wales," p.446.

§ Rec. Geol. Surv. N. S. Wales, Vol. v. p.147.

bedded, lenticular beds of limestone. The andesites are a portio of a large area stretching out to the west, and are rather decom posed and uralitised, sometimes with the formation of tremoliti asbestos. The slates have been intruded by a large granit massif, part of that which forms the Bathurst plains, whic sent into the slate such vein-rocks as granite, granophyre an aplite. The slate was considerably metamorphosed by thes both at the contact and to some extent regionally. A goo series of contact-metamorposed slates can be traced towards th massif, viz., slate passing into knotted slate, chiastolite slate, an mica slate. Felspathic and augen slates also occur, but these ar more correctly referable to regional metamorphosis.

The limestone has become marble, and in favourable localiti has been metasomatically replaced by copper ores, or changed b a similar process into actinolite schists. The occurrence of chlorite schist has been noted, but its mode of origin at preser remains unexplained. Lastly, the economic minerals have bee briefly described, and it has been shown that marble, iron or and gold are the only minerals in this district likely to be much value.

ix.—Conclusion.

I am indebted to Mr. L. V. Puckle, Secretary to the Commo wealth Marble Quarries, Ltd., for information concerning, an permission to inspect, the marble quarries; and to his quarr manager, Mr. F. T. Campbell, for pointing out the smalle occurrences of marble.

Mr. H. J. Meldrum, B.Sc., has very kindly analysed the slat for me. My thanks are especially due to Dr. Woolnough, fo much advice and assistance in the preparation of this paper an its illustrations.

Note.—Since writing the above, I have learnt, from Mr. R. H Cambage, that basalt occurs capping Sugarloaf Hill. This is o the northern border of Galbraith Parish, and I was unable t visit it.

EXPLANATION OF PLATES.

Plate xxii.

Geological Map of Newbridge.

Plate xxiii.

Fig. 1.—Andesite from Smith's Hill. At the top a large crystal of augite may be clearly seen, and below it a mass of fibrous chlorite. The crystals of felspar stand out clearly against a matrix of decomposed glassy matter.

Fig. 2.—The granophyre referred to on page 532. As may be seen, it is a perfect example of an intergrowth of quartz and felspar.

Fig. 3.—A junction of mica slate and granite. The latter has absorbed a little of the colourless part of the slate as may be seen from the fact that the biotites project into the granite. This specimen is remarkable for the coarseness of grain of the mica slate.

Fig. 4.—A junction of mica slate and granophyre. This is very different from Fig. 3. The slate is finer-grained, and contains much magnetite. The granophyre has greatly disrupted the slate. Note the potential andalusite crystal on the lower margin.

Fig. 5.—Chiastolite slate. The chiastolite occurs in black, rectangular grains; and is sometimes in a cruciform twin.

Fig. 6.—Chiastolite slate. Notice the light halo round each crystal. A centimetre scale is shown to give an idea of the size of the crystals.

WEDNESDAY, AUGUST 28TH, 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 28th, 1907.

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 5 Vols., 51 Parts or Nos., 4 Bulletins, 3 Reports, 9 Pamphlets, received from 43 Societies, &c., and 3 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. David G. Stead offered a preliminary record of the occurrence of that most archaic of modern Selachian forms, *Chlamydoselachus*, in the waters of New South Wales, an announcement which would be received with great interest by zoologists. The record was based upon portions of a specimen cast ashore some time since, in Rose Bay, Port Jackson, comprising the skull and about 150 vertebræ. The specimen measured more than 10 feet in length. Only one species of the genus is known, *C. anguineus* Garman, from the Sea of Sagami, Japan, as well as from deep waters in the vicinity of Madeira, the Azores and the coast of Norway; while the length of the largest specimens hitherto known, appeared to be about 5 feet.

Dr. J. B. Cleland of Perth, W.A., contributed a Note on "The Resistance of the Vegetation of Australia to Bush-Fires, and the Antiquity of the Australian Aboriginal," with the object of suggesting that, if it can be proved that the vegetation of Australia has been modified in the course of ages so as to have

become more tolerant of bush-fires, and as a result of the frequency of such fires; and if the frequency of such fires can be regarded as due mainly to the agency of man, then there would seem to be some grounds for attributing considerable antiquity to the presence of fire-producing man in that region, and therefore, presumably to the ancestors of the vanishing Aboriginal Australian. It is not difficult to accumulate facts which indicate that certain Australian genera and species of plants are peculiarly resistant to destruction by fire. Among such may be mentioned the remarkable recovery of Eucalypts, Proteads, and others after bush-fires; the characteristics of the woody fruits of many proteads which afford the seeds protection from fire, but the opening of which, with the concomitant scattering of the seeds, is favoured by a fire; the fact that the germination of the seeds of the Acacias is facilitated by heat (*e.g.*, immersion in boiling water); the case of the orchid, *Lyperanthus nigricans* which rarely, if ever, flowers except in ground recently burnt over. Though these peculiarities of resistance to fire-destruction seem very noteworthy, it is another matter to assert that they are the evolutionary result of the frequency of bush-fires. Adaptation to arid conditions of long continuance may perhaps account for some of them. Though bush-fires occasionally originate through other than human agency, it seems not unreasonable to suppose that Man is the only likely cause of frequent conflagrations of that character.

It will be seen that three propositions require proof if the theory suggested is to be accorded any support. They are :—

(1) Has the Australian vegetation any peculiarities which render it specially resistant to destruction by fire? The answer to this seems to be undoubtedly yes.

(2) Are these peculiarities the result of the frequency of these fires, or can they be satisfactorily explained otherwise?

(3) If due to the frequency of such fires, could other agencies than those of man produce them frequently enough to so modify the vegetation?

Discussion was postponed to next Meeting.

Mr. Jensen exhibited a series of photographs and petrolog specimens, illustrating the geology of the Warrumbungle Mo tains. Lantern slides will be shown at a future Meeting, w the geology of the Nandewar Mountains is treated of.

Mr. Fletcher showed germinating seeds and young seedlings to 4 inches, of a common leafless parasite, *Cassytha pubescens* R. one of the Dodder-Laurels [N.O. LAURINEÆ]. The portion of embryo which emerges from the seed is at first cylindri shortly becoming club-shaped; meanwhile the rudiments of roots, of which there are usually three, appear as a median two lateral projections—sometimes only two are developed. roots and root-hairs of seedlings no older than those exhibi attain considerable development; in this respect, as also the presence of chlorophyll in the young stems, differing marke from young Dodder plants [N. O. CONVOLVULACEÆ] (as descril in text-books, *e.g.*, Kerner and Oliver's "Nat. Hist. of Plan i. 173), to which at an early stage they offer some resemblan A leafless condition characterises both types.

THE GEOLOGY OF THE WARRUMBUNGLE MOUNTAINS.

By H. I. Jensen, B.Sc., Linnean Macleay Fellow of the Society in Geology.

(Plates xxiv.-xxxii.)

Synopsis.

A. Geology.

1. Introduction.

The Warrumbungle Mountains proper lie about 70-80 miles W.S.W. of Gunnedah, and about the same distance N.N.E. of Dubbo, the two nearest and most convenient railway centres; and between the townships of Coonabarabran, Mundooran, Tooraweanah and Baradine, which are the nearest places where stores and accommodation can be obtained.

The Warrumbungle Mountain Region is roughly circular in shape, with a diameter of from 30 to 40 miles.

I spent two months in the district in 1905 (October and November) and nearly two months in 1906 (also October and

November), so that the observations here recorded represe field-work occupying a period of nearly four months.

During my field-work I derived much information about t country and cordial assistance from men stationed in the distri To Mr. Goodridge, Licensed Surveyor, I am particularly indebt for his never-failing courtesy and help. Dr. F. Failes of Coor barabran, Mr. May-Steers (Stock Inspector), Messrs. John Knigl Senr., and Alfred Knight of Tannabar Station, Mr. Lawren Brown of Tundebrine Station, Mr. J. Draper (Tundebrine), M Goldfinch of Gowang, Mr. Wright (Road Inspector), and ma others have rendered me valuable help. To Mr. A. Wallace am indebted for his cheerful company on my first trip throu the mountains. On my second trip I was accompanied by r brother, Mr. Thor Jensen, L.S.

Owing to the rough nature of the country, it was necessary work this district by camping out in various places to whi access could be attained with a vehicle, and making excursio on foot from the camps in all directions. During the work have been camped at the following places:—Coonabarabra Riversdale, Tannabar, Gowang, Uargon Creek, Tooraweana Tundebrine, Tenandra, Goorianawa, Bugaldi, Upper Bugal Creek and Yarraman. By working from these localities it w found possible to visit all the most important peaks of the gro and to acquire a good idea of its geological structure.

Work of a detailed nature has never been done in the distri before, with the exception of Professor T. W. Edgeworth Davi description of the diatomaceous earth and tuff-beds at Wan allabah (Wantialable?) Creek.* The Rev. J. M. Curran h visited the district on several occasions, but has not publish anything about it. Mr. Pittman and officers of the Geologic Survey have made hurried trips to special localities in the regi to report on mining claims, but have done no detailed geologic work. To Sydney people the district is only known through t photographic zeal of His Honor, Judge Docker, who has do

* These Proceedings, 1896, p.264.

so much in this way to open up and make known the beauty spots of New South Wales.

Owing to the very characteristic physiography of the Warrumbungles, I published a preliminary note on that subject last year.*†

2. Petrography.

The rocks of the Warrumbungle Mountains fall under the headings Sedimentary, Pyroclastic, and Volcanic.

The *Sedimentary Rocks* consist of sandstones, shales, calcareous shales, conglomerates and recent alluvial. The Permo-Carboniferous System (Upper Coal Measures) is met with in most places E. and S.E. of the Warrumbungles, and consists of clay-shales, coal seams, sandstones, and conglomerates, which have, as a general rule, a dip to the S.W. of 1 in 20. Dolerite sheets or *sills* of pre-Tertiary age occur in connection with these rocks. In places we meet with mesas of sandstone of later (Triassic or Trias-Jura) age dipping N.W., and capping the Permo-Carboniferous, *e.g.*, Mow Rock, etc.; and cappings of andesite and basalt of Tertiary age are also common.

In the Warrumbungles proper, to the north of them (in the Pilliga Scrub), and north-east at Ulimambra we meet with sandstones and conglomerates which have, when not much disturbed by igneous intrusions, a N.W. dip of 5°-10°. These rocks have the usual barren look of Australian Triassic and Trias-Jura

*These Proceedings, 1906, p.228.

†Since the above was written the Government Geologist, Mr. E. F. Pittman, A.R.S.M., has lately contributed a "Note on the Occurrence of Precious Opal at Tooraweanah, Warrumbungle Mountains," and Mr. Henry Deane, M.A., F.L.S., some "Notes on the Fossil Leaves from the Warrumbungle Mountains" to the last issue of the Records of the Geological Survey of New South Wales (Vol. viii., Part 3, 1907, pp. 187 and 189).

Mr. Deane's investigations show conclusively that the trachytic eruptions were of the early Tertiary age, for the tuffs in which the leaves examined by Mr. Deane are found occur sometimes interbedded with trachytic flows, sometimes overlying a trachyte flow and underlying a later basalt flow.

Both the above papers bring corroborative evidence for conclusions which I have come to in this paper.

formations. Naturally in the centre of the volcanic region dips are much disturbed. West of the Warrumbungles we find, at Tenandra, calcareous shales dipping W. at 10°—probably of Upper Trias-Jura or Cretaceous age. These too are intruded by andesitic eruptives (Tenandra Mountain) coeval with the Warrumbungle lavas.

At Scabby Rock, about 10 miles north of Coonabarabran, we find the trachytic knob surrounded by a narrow rim of highly inclined slates with quartz reefs, surrounding which we find gently inclined Triassic (or Permo-Carboniferous) sandstones. The slaty rocks are probably of Gympie (Carboniferous) age. (Figs. 4*a* and *b*).

At Timor Rock, about 8 miles west of Coonabarabran, fragments of chert are included in the trachyte. Several fine specimens of chert with *Glossopteris* (Permo-Carboniferous) were collected by Mr. McLeod, until lately schoolmaster at Bugaldi, near Wheoh Mountain on Upper Bugaldi Creek. I have been unable to find the outcrop, which is probably small, and brought to the surface by an igneous intrusion.

These occurrences, however, prove that rocks older than the Triassic occur at no great depth. One might also mention in this connection that at Tundebrine Station pieces of quartz and fragments of biotite granite have been brought to the surface by volcanic action.

The *Pyroclastic Rocks* consist of tuffs and breccias. Interbedded with them occur diatomaceous earths at Bugaldi, Yarraman, Wandiallabah Creek and Gowang. Tuffs and breccias of the arfvedsonite trachyte-comendite series were met with at Gowang, Wandiallabah Creek, Berum Buckle (Tannabar), Timor, Scabby Rock and Siding Spring Mountain. They occur very abundantly everywhere in the heart of the Warrumbungle Mountain group in association with the trachytes related to them. Andesitic and basic tuffs occur in association with more basic lavas on top of Mount Exmouth, at Chalk Mountain, Cow Mountain, Lion's Head, Paddy McCulloch's Mountain, and other

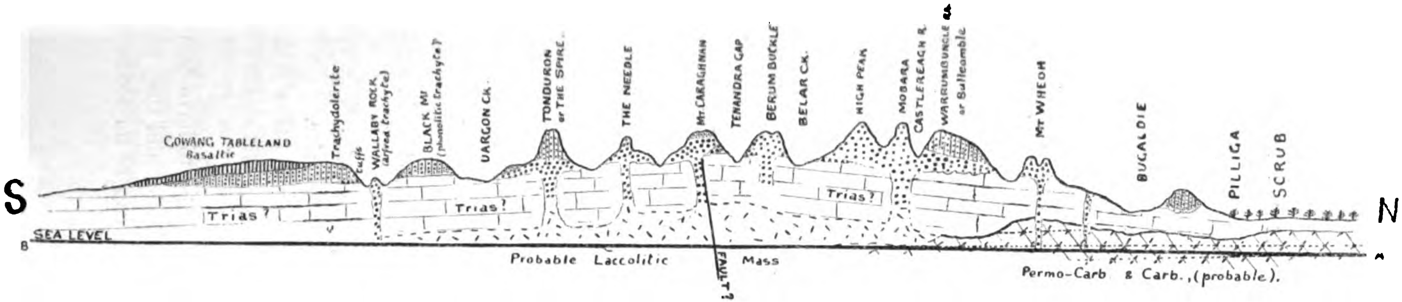

Fig. 1 Section N & S along the line AB
WARRUMBUNGLE MTS (diagrammatic)

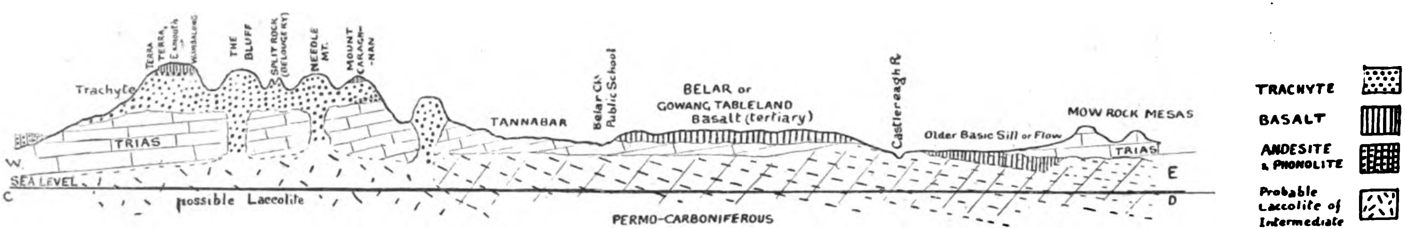

Fig 2 Section E & W along the line CD
WARRUMBUNGLE MTS (diagrammatic)

mountains round Bugaldi Creek, at Gowang and numerous other places.

The *Volcanic Rocks* include (a) light grey *arfvedsonite trachytes* which form the main bulk of the mountains in the heart of the group, such as Timor, Mobara, Siding Spring Mountain, Berum Buckle, Mount Caraghnan, Needle Mountain, The Bluff, Wombalong (Terra-Terra or Exmouth) and The Spire.

(b) Dark bluish *ægirine trachytes*, nepheline-ægirine phonolites and allied rocks, capping the arfvedsonite rock in places, as on Mount Caraghnan, and extending all round them in a sheet now dissected by gorges and wider creek valleys; the Warrumbungle Range north of the Castlereagh River from Timor to Coonabarabran is capped with this rock, as is also the ridge known as Naman Ledges; Tooraweanah Mountain, the Dillys (south of Tooraweanah), the Ridge Pole S.W. of Tannabar, Mount Tannabar and most of the spurs north of the Warrumbungle Range, such as Kalga Range, the Bugaldi Spur and the Yarraman Spur, have similar cappings.

(c) Grey nosean and pseudoleucite phonolites at Mount Bingy Grumble, Berum Buckle and round the base of Mount Caraghnan.

(d) Trachydolerite with sodalite, olivine, augite, ægirine and soda felspars at Uargon Creek covering much of the tableland south of Black Mountain, and forming part of The Spire pinnacle (Tonduron). The rock which forms the butte-like hills of the Forked Mountain and Nandi near Coonabarabran is closely related.

(e) Melilite basalts or basanites at Billy King's Creek, a couple of miles south of Coonabarabran.

(f) Sodalite basalt at Mount Gowang, The Spire, and other places, a differentiation-product of the trachydolerite.

(g) Ordinary andesites and basalts capping the other rocks in places, as on the top of Mount Wombalong (Exmouth), and spreading over a much wider area.

Sequence.—The sequence of the lavas seems to have been in general from the more acid to the more basic; and they merge into one another in such a way that there can be no doubt that

they all belong to one rather long period of volcanic activity, probably, for reasons given later, lasting from the Eocene to the Pliocene. In the preceding paragraphs the lavas are mentioned practically in the order of sequence. South of Black Mountain basalts cap trachydolerites and are unquestionably the last outpourings. North of the Warrumbungle Range around Bugaldi basalts cap trachytic and phonolitic rocks. The age of the dark green or blue trachytic rocks (with associated phonolites) relative to the light grey arfvedsonite trachytes is harder to decide. At Mount Caraghnan there is a capping of the former on the latter; but more usually, excepting in the central mass of mountains, the light grey trachytes exist only as isolated knobs, either standing in a valley surrounded only by sandstone and occasionally

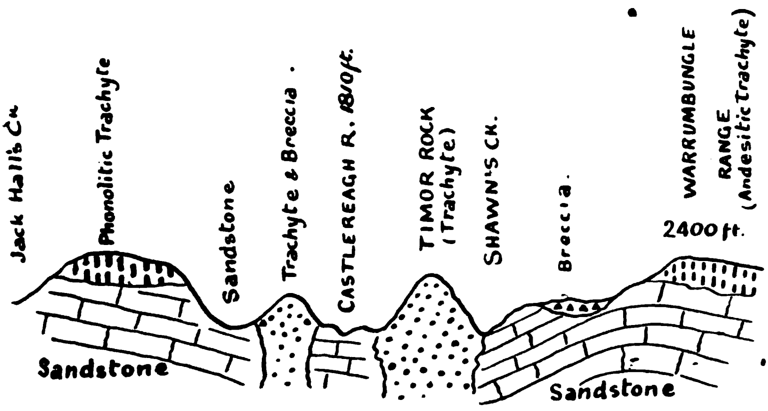

Fig.3.—Diagrammatic Section from the Warrumbungle Range to Jack Hall's Creek through Timor Rock.

tuff as Wallaby Rock near Uargon Creek (see Figs.1 and 5 *postea*), Scabby Rock (Figs.4*a* and *b*), Timor Rock (Fig.3); or surrounded by tuffs, and sometimes capped with basalt as at Gowang; or completely surrounded by the dark variety of trachyte, as Paddy's Rock in the Naman Ledges. This last kind of occurrence suggests that the more acid rock has been thrust into the more basic, a sequence which is not verified by occurrences elsewhere. The only explanation which satisfies all the facts is that the arfved-

sonite trachytes were the earliest lavas and were in many case injected into earlier tuff cones. Their maximum developmen was attained between Mount Wombalong, Berum Buckle an

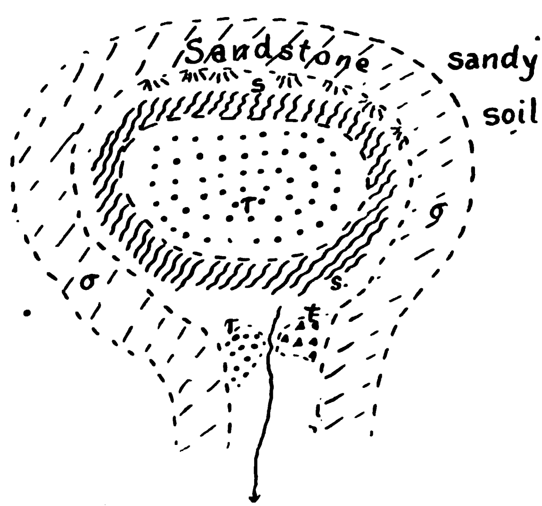

Fig. 4*a*.—Plan of Scabby Rock (diagrammatic).
τ, trachyte; *s*, slate; *σ*, sandstone; *t*, tuff.

Mobara. Later flows of more basic lava followed, and thi being of a more fluid nature, filled the valleys around the centr group and surrounded outlying members of the more acid serie

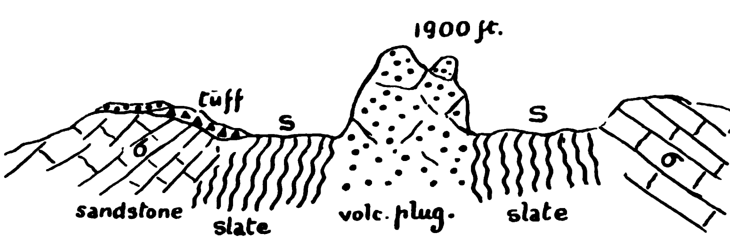

Fig. 4*b*.—Diagrammatic Section N. and S. through Scabby Rock.

forming an extensive lava-field sloping in all directions from th central mass. Subsequent erosion has carved valleys througl this lava-field, reaching the sandstone below. The earlier arfved

sonite-trachyte plugs being surrounded by soft tuffs, have, in many cases, been isolated by the erosion.

Dykes of arfvedsonite-trachyte have been met with cutting the Triassic sandstones at Tannabar, behind The Spire, at Gibb's Pass and many other places, so that the earliest lavas are at least post-Triassic. Tuffs belonging to this series are, however, associated, at Gowang and Wandiallabah Creek, with leaves of *Cinnamomum Leichhardtii* and other leaves of Eocene appearance. This fixes the commencement of volcanic action as somewhere about the Eocene.

Distinct sills and laccolites I have not seen anywhere.

3. Physiographic Notes.

An observer standing on one of the central peaks such as Wombalong, Berum Buckle or Siding Spring Mountain, would observe (a) that the elevation of the mountains diminishes as the central group is receded from; and (b) that the watercourses pursue very direct paths outwards from the central group in all directions; when the streams reach the "plains" country they commence to deviate from their original straight courses. They are therefore "consequent."

The central mountains are very rugged. The surrounding zone of darker rocks is characterised by almost flat-topped mountains and ridges, sloping gently away from the central area. The watercourses are often wider inside the zone of dark trachytes than in it. Thus the Castlereagh River at Timor (Fig.3) has a wide valley, having had soft tuffs and sandstone to work in, but flows in a narrow V-shaped valley thence to Coonabarabran; Uargon Creek occupies a wide flat valley in the sandstone country north of Black Mountain and east of Tonduron, but runs in a narrow gorge between the Naman Ledges and Black Mountain (Fig.5). Wandiallabah Creek and Belar Creek show the same peculiarities. Where the creeks leave the inner sandstones and tuffs surrounding the light-coloured trachytes and flow through the hard ægirine trachytes and phonolites, erosion has not been able to widen the valleys at the same rate as higher up.

The Warrumbungle Mountains are drained by the tributaries of the Namoi and Castlereagh Rivers. The former is a consequent stream, throughout most of its course following the dip

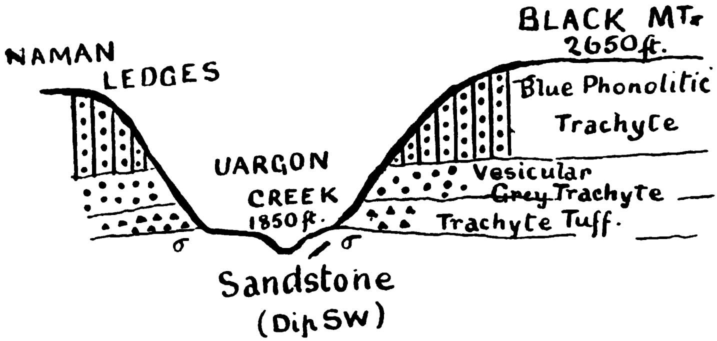

Fig.5.—Diagrammatic Section showing the structure of Goat Mountain, Tannabar.

of the Trias-Jura (or Trias) rocks in a N.N.W. direction. Probably it is a very old river, as Mr. E. C. Andrews has pointed out,* originating in its present course when the Triassic sediments were tilted in Cretaceous time. It follows that, where these sediments have been denuded away and the Namoi runs through Permo-Carboniferous rocks dipping S.W., it occupies a subsequent position, and is in reality a *superimposed* stream. In some places it cuts through deep alluvial plains of its own deposition, as at Narrabri. Many of its tributaries are *subsequent* streams running N.E., following the strike of the Trias-Jura. The Namoi is older than the raised peneplain marked by the mesas of Coonabarabran. The erosion produced by tributaries like Brigalow Creek, Baradine Creek, Bohena Creek and Bugaldi Creek has given rise to similar mesas of about the same altitude in the Pilliga Scrub, north of the Warrumbungle Range.

The Castlereagh rises in the Warrumbungles near Mobara. First it pursues an easterly course through a wide gorge or valley, with steep cliffs bounding it on the north. A few miles

* "Tertiary History of New England," Records Geol. Survey N. S. Wales, Vol. vii. 1903, p.27.

east of Coonabarabran it swings round and flows south, first in a narrow deep trough, later, about 10 miles south of Coonabarabran, in a shallow bed little below the level of the plain (Riversdale). Later, at Mundooran, the course swings to the west, and, still further on at Breelong, it takes a north-westerly direction which it preserves till the Darling is reached. Thus this river describes a spiral course round the Warrumbungles.

There can be little doubt that the drainage was more direct prior to the volcanic outbursts. There was probably a consequent stream draining the Liverpool Plains in the same direction as the Namoi and Macquarie. The great effusive pile of the Warrumbungles, however, effectively blocked it, and a new, more circuitous drainage-system had to develop. This accounts for the youthful appearance of the Castlereagh as compared with the Namoi. The poorness of the water-supply in the Castlereagh, and the development of *monkeys* (aboriginal "*moongies*") in its course I have already touched upon in my preliminary note.* Here, too, I mentioned how the creeks flowing westward from the Warrumbungles dry up, and have beds so little depressed below the general level that the traveller hardly notices when he crosses a creek. The drying up of streams on reaching the level country was also noticed in the Pilliga country. The water coming down from the mountain springs may be absorbed by the outcrop of porous artesian strata at a level of about 1,400 feet. Certain it is that the rainfall at the present day is insufficient to enable the streams to erode beds, but the existence of dry water-courses infilled with sand shows that at a remote period there was a better rainfall.

The watershed known as the Warrumbungle Range divides the drainage-areas of the Castlereagh and the Namoi. It commences as an offshoot of the Liverpool Range, east of Coolah, first runs N.W., then W., losing itself in the Warrumbungle Mountains to the N.W. of Coonabarabran; then it re-emerges as the Kalga Range at Bulloway Mountain. The Kalga Range

* These Proceedings, 1906, p.231.

runs N.N.W., gradually diminishing in altitude, until it is lo in the Pilliga Scrub to the N.W. of Baradine. The Warru bungle Range has only an average height of about 2,000 fe and is composed essentially of sandstones, conglomerates a shales which belong to the Triassic to the north-west and nor of Coonabarabran, but to the east and south-east they probab belong to the Permo-Carboniferous (Upper Coal Measures).

The highest peaks of the Warrumbungle Mountains themselv attain an altitude of about 4,000 feet. In the centre of t group we have Wombalong (4,210), Terra Terra (3,710), T Bluff (about 4,000), Mt. Caraghnan (3,875), Berum Buckle (3,71 and Belougery Split Rock. Practically situated on the Warru bungle Range, where it approaches most closely to the centre the mountain group, are the high peaks of the Siding Spri Mountain (about 4,000), Mobara and Bulleamble. Mt. Bul way, at the commencement of the Kalga Range, is apparen also about 4,000 feet high.*

The zone of table-topped mountains and spurs of dark trachy and phonolite surrounding the central mass attains usually to t height of from 2,000 to 2,500 feet. Thus Timor Ledges, nor of Timor Rock, are 2,400 feet high, Black Mountain and Nam Ledges 2,500-2,600, Gowang Tableland 2,200-2,500; Kal Range, Paddy McCulloch's Mountain and the Bugaldi Rang reach 2,000-2,500 near the Bugaldi-Tenandra Road, but drop lower levels further northward.

In the valleys between the mountains are numerous small knobs, steep-sided plugs and sugarloaf-shaped cones. These a particularly abundant in the Gumin-Gumin Valley; Plate xxvi illustrates their appearance.

The level at Coonabarabran is about 1,700 feet. At Rive dale, 10 miles or so to the S.S.E., it has fallen to about 1,4

* The elevations given in this paper can only be taken as approxima being based on aneroid measurements checked by comparisons with t official barometric readings taken at Coonabarabran, for which I am indebt to the Postmaster. The altitude of Coonabarabran was taken to be ab 1,700 feet.

feet. At Tooraweanah, to the S.W. of the mountains, it is about 1,500 feet; and at Tundebrine about 1,400 feet. At Tenandra Station it has fallen to about 1,100 feet; at Goorianawa Station the level is 1,200 feet; at Bugaldi it is about 1,350. Mundooran is about 1,000 feet above sea-level, Gumin-Gumin about 1,200, and Kalga 900 feet.

We see then that there is a tendency for the level to drop rapidly to that of the western plains around, *i.e.*, to about 900-1,100 feet. Around Coonabarabran there is a tableland elevated 400-500 feet above the Liverpool Plains to the S.E. Studded over this tableland are flat-topped sandstone mesas, and buttes of trachyte; the former all reach a level of between 1,900 and 2,000 feet—the same height as the Warrumbungle Range where it is composed of sandstone. The trachytic buttes, *e.g.*, Nandi, The Forked Mountain, Yarrighnan, Yarabala, etc., usually attain the same altitude, but frequently vary within wider limits. Very often trachyte caps a sandstone mesa, thereby increasing its altitude. The buttes and cappings represent remains of a sheet of lava which filled the valleys in the sandstone in the volcanic period. The lavas in the Warrumbungle Mountains proper overlie a continuation of this Coonabarabran plateau.

The foregoing description of the Warrumbungle Mountain topography with a glance at the reproduction of a stereogram (Plate xxv.) shows that the region has the nature of a lava conoplain, as pointed out in my preliminary note.

South and west of the mountain group we also find mesas and buttes which were originally portions of the Warrumbungle conoplain, but are now severed by erosion. Thus between Tooraweanah and Bearbung there are the Dillys, masses of sandstone with steep, often vertical walls, which overlie conglomerates (probably Permo-Carboniferous), and are in some cases capped with trachyandesite at a level of 2,000 feet. Similar masses occur north of the Warrumbungles in the Pilliga Scrub.

The soils are very different in different parts. In the sandstone belts they are poor and sandy, and characterised by pine (*Callitris robusta* and *C. calcarata*) and white gum (*Eucalyptus*

tereticornis var. *dealbata*, and *E. coriacea* [?]) forests, with o
(*Casuarina Cunninghamii*, *C. Luehmanni*) and belar (*C. C*
bagei) along the banks of creeks. In the arfvedsonite-trach
region the soil is still poor, but somewhat better than in
sandstone country; pine trees are here typically absent. T
dark trachytes and trachyphonolites have fair red soils, and
timbered with gums, ironbarks (chiefly *Eucalyptus siderophlo*
wattles, pine (*Callitris robusta*), emu-bush (*Eremophila* s
Styphelia sp., etc. The trachydolerites and basalts are surroun
by good red and black soils, commonly timbered with box (*Eu*
lyptus hemiphloia var. *albens*) and a fair sprinkling of kurraj
(*Sterculia diversifolia*). Outside the mountain region we h
the extremely poor and thirsty sandy soils of the Pilliga Sc
to the north, thickly timbered with pine (*Callitris calcara*
and the vast black soil plains lying to the west and south-w
Interspersed with the black soil plains there are belts of wretc
sandy soil of the Pilliga type. In some of the valleys in
mountains, as at Tundebrine and around Tooraweanah, wh
basaltic detritus accumulates, and where wash from basic trachy
is deposited, there are miniature black soil plains, in real
occupying the position of alluvial fans. From the close res
blance of the black soil in these valleys to that of the plains,
colour, touch, mode of cracking when dry, and vegetation it see
very likely that the black soil plains owe their richness to detri
brought down from the Warrumbungle Mountains in the cou
of ages. The black soil of the plains contains deposits of coa
gravels and waterworn pebbles made up partly of volcanic r
of the Warrumbungle type, and partly of quartz derived fr
the breaking up of the conglomerates. These coarse materi
must have been carried down at a time when the rainfall w
greater in the mountains than at present.

Wind-action is an important factor in redistribution in th
areas, but as the winds here are mostly westerly, they have n
taken any part in bringing down the detritus which formed t
black soil plains. The wind, however, is an important distribu
of pests. Almost every year produces a new variety of thist

or other noxious herb, which completely monopolises the plains for the season, and only dies out to give the monopoly to a plague of something else. The winds bring the seeds from the west. The rabbit also helps the invader by shunning it for a while, and feeding on the diet he is used to. It is due to the rabbit that prickly species of thistles, unsuited for feed, are getting the upper hand on the plains.

The sandy soils of the Pilliga Scrub are, I am told, very deep in places, and must have been deposited partly by the aid of water in the rainy period, and partly by wind-action in the present arid cycle.

A striking instance of *natural pruning* is seen, throughout the Pilliga Scrub, in the uniform height above ground of the lowest branches of the pine forests.

Black soil plains are often devoid of forest trees. This is due mainly to the fact that they tend to become swampy in wet weather, and to scorch up, cake and crack in dry weather. Where the black soil is loamy, such trees as box (*Eucalyptus Woollsiana* ?), silver-leaved ironbark (*Eucalyptus melanophloia*), kurrajong, wattles and myalls are common.

4. Geomorphogeny.

(a) *Pre-Cretaceous Configuration.*—The Warrumbungle area was probably submerged in Carboniferous times, being the western margin of a sea which stretched across to the New England border. Elevation followed. In late Permo-Carboniferous times parts of it, especially the eastern and southern quartants, were depressed, and received sandy and gritty sediments (the Upper Coal Measures) probably from the west. In Triassic times the whole area was again submerged. The subsidence continued, with interruptions, until in Cretaceous time a movement of elevation or negative movement of the sea, probably connected with a general uplift in the Liverpool Range and New England, again made the area dry land. This uplift gave the Triassic sediments a N.N.W. dip, just as the uplift of the New

England area at the end of the Permo-Carboniferous gave
Upper Coal Measures a S.W. dip.

(b) *Stream-Development.*—In Cretaceous times the pres
drainage-system commenced, the rivers like the Namoi, Cas
reagh (lower part) and the Macquarie taking a consequent di
tion, and flowing, therefore, N.N.W. The uplift continued
some time, but the rainfall being good, on account of a Cretace
sea lying to the N.W., erosion almost kept pace with the up
Tributary *subsequent* streams like the Talbragar River, Barad
Creek, etc., now developed, and low watersheds like the Warr
bungle Range were formed by erosion. A stationary pe
following, allowed most of the country to be reduced to a pe
plain, at present marked by the 2,000 feet level mesas all ro
the Warrumbungles. In the centre of the group there wa
sandstone area which had not yet been quite reduced to a le
but was diversified with ridges and valleys. This takes us
early Tertiary (Eocene) times. Now volcanic action commenc
and the lavas built up the central mass to a great height; wh
subsequent outpourings not only filled up any valleys in
country around, but covered the peneplain over a considera
area with a lava-sheet thinning out away from the central ma
In this way it is possible to explain that some lava hills l
Nandi near Coonabarabran, Yarrighnan and Yarabala n
Bugaldi, rest on sandstone at a level of from 1,500 to 1,700 fe
being relics of flows filling valleys; whilst in most cases the la
rest on the sandstone at a level of from 1,900 to 2,000 feet, be
cappings on the old peneplain level (*e.g.*, cappings around Coo
barabran on the Warrumbungle Range, around Bugaldi, on t
"Dillys," etc., etc.). In fact there seems to have been a slig
uplift and recommencement of stream-dissection in the a
before the ægirine trachytes, phonolites and basalts were pou
out. This uplift was probably due to the injection of sills at t
period of eruption of the arfvedsonite-trachytes.

The drainage of this area was now altered. The waters h
to find their way round a great effusive pile. In this way t
Castlereagh developed.

The late Cretaceous sea being now again dry land, the streams from the mountains deposited much of their silt on the plains, where the velocity decreased on reaching the more level country, thus giving rise to the Black Soil Plains. Valleys were carved in the volcanic conoplain, dissecting the lava-sheets and underlying sandstones. Thus the Castlereagh at Timor has cut through the phonolitic trachytes into the sandstones below. Likewise Uargon Creek flows between the vertical cliffs of Naman Ledges (a flow from The Spire crater, probably), and Black Mountain at a level of about 1,850 feet. At the 2,000-feet level on either side the sandstone is capped by lavas which the creek erosion has severed (Fig.5). In such cases the valley widens by the retreat of almost vertical cliffs, formed by the sandstone weathering away from under the lava-capping.

(c) *Peneplanation.*—As has been shown above, a peneplain, now marked by the 2,000-feet level, was formed at the end of Cretaceous time. Subsequent erosion has not produced another peneplain, yet the Coonabarabran tableland is approaching that end. However, the late Tertiary erosion has tended to reduce or base-level the land, not to sea-level, but to the level of the western plains. Following upon a wet period—probably Pleistocene or Pliocene, and contemporaneous with the lake period of parts of Central Australia, when an inland sea covered great areas—there succeeded a dry period, which still persists. This matter I have already touched upon in my preliminary note.

As evidence proving the existence of an *Arid Cycle** in the area of this Warrumbungle conoplain, the following facts are sufficient:—

(1) The streams have definite courses in the mountains where they are fed by springs, but dry up and become indefinite on reaching the more level country, especially to the north and west of the Warrumbungles.

(2) The country is being base-levelled to the level of certain depressions in the western plains, which have become filled with detritus (black soil) from the mountains.

* Cp. Journal of Geology, Vol. xiii. No. 5, July, August, 1905.

(3) The drainage is therefore disintegrated. The Castlere
River itself is a striking example, with its dry beds and bi
bongs distinguished from the surrounding and more lowly
country only by a ridge of wind-blown sand (*monkey* or *moong*
Many other creek-beds, no longer serving as water-courses,
present. Evidently in the arid period the integrated draina
system established in the wet period has been destroyed.
age of arid erosion has been reached in the country west of
mountains, and maturity on the Coonabarabran tableland. O
in the mountains themselves, on account of the hardness of
rocks, has a youthful appearance been maintained.

(4) "Scorched plains" devoid of soil, flat-topped stony hi
and slopes covered with coarse shingle instead of soil, ha
developed in the volcanic mountains; and around Coonabarabr
a typical *bad-land* topography has been shaped.

(5) Alluvial fans occur in the valleys where declivity lesse
or where the streams reach the plains, as at Tundebrine.

(6) There are no post-Tertiary fossils, except a few plant-rema
and bones of terrestrial animals, in the surrounding country.
marine or lacustrine Tertiary fossils have been met with eith
so that there is reason to believe that throughout Cainozoic tin
land-conditions have prevailed.

(7) The Coonabarabran tableland, with its buttes and mes
has the character which Passarge terms *Inselberglandscha*
shaped mainly by wind-erosion.

Some of the above facts are also characteristics of a conopla
as defined by Miss Ida H. Ogilvie.*

The main reasons for looking upon the Warrumbungles as
conoplain may, however, be summarised in the following word

(1) The mountains form an eroded lava-dome. This consist
of a high core of light grey trachytes, surrounded and capped
a sheet of phonolitic trachytes, which were again covered wi
later basalts.

* "The High Altitude Conoplain." The American Geologist, Vol. xxx
No.1, July, 1905.

(2) The streams diverge from a common centre.

(3) The valleys widen by the retreat of vertical cliffs.

(4) Alluvial fans are common. Detritus is deposited all round the mountains where the grade diminishes.

(5) The watercourses frequently change their position; or the waters flow in a sheet when the plains are reached, following no definite course.

The rainfall in the Warrumbungles comes mostly in *heavy showers* separated by long *dry intervals.* This kind of rainfall favours arid erosion and conoplain-formation.

(d) *Vulcanism.*—The sequence of the lavas has already been described. Eruptions commenced probably in the *Eocene* period, and continued for a considerable time. The alkaline trachydolerites and basanites may have been as late as Miocene, and the calcic basalts which followed in places may be as late as Pliocene. Owing to the absence of fossils we have only the land forms to enable us to arrive at an approximation in this regard. The eruptions had finished when the very wet cycle commenced.

Volcanic action was throughout accompanied by elevation. The plugs and cones are not distributed along definite intersecting cracks as in the Glass House Mountains. If such cracks ever existed, their traces have been hidden by the enormous amount of lava poured out. Although the igneous mass occupies a somewhat circular area, there is reason to believe that the lava was erupted mainly from a fissure running N.N.E.-S.S.W., through Mount Wheoh, Siding Spring Mountain or Mombara, Berum Buckle, and The Spire (Tonduron). Berum Buckle at Tannabar is apparently the centre of the whole system. Radial cracks were probably developed, originating at this point. One fracture might be imagined running west through Caraghnan, Needle Mountain, The Bluff and Wombalong (Exmouth); another east through Goat Mountain and Bingy Grumble.

In the country around The Spire the sandstone nearly always reaches a higher level on the western side of a mass than on the eastern. This would seem to indicate that the lava came up diagonally from the west.

Possibly the weight of Mesozoic sediments to the west, after Cretaceous sedimentation, has contributed to squeeze underlying magmas away in an easterly direction.

The diagrammatic plan and section (Figs. 6*a* and *b*) illustrate the structure of The Spire, which is typical of that of many of the other plugs.

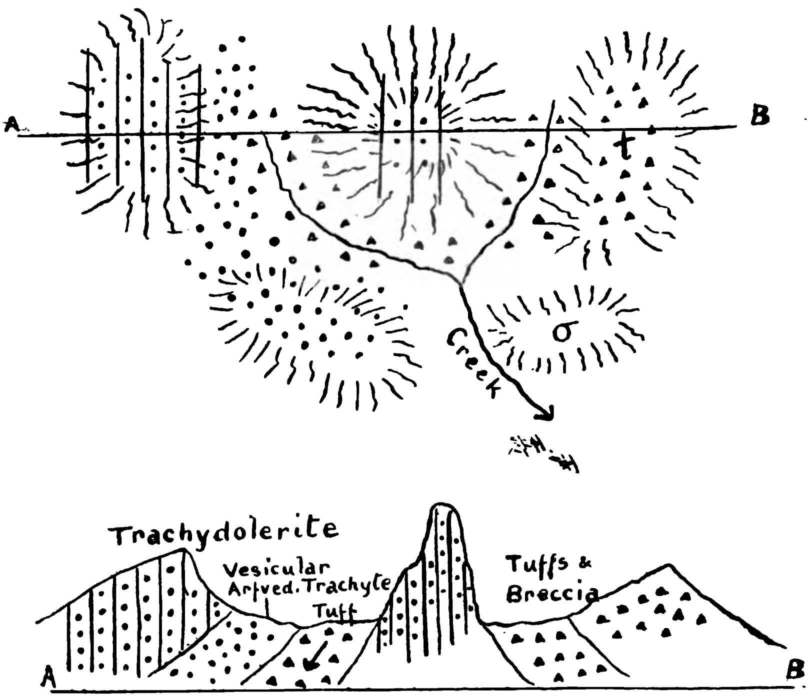

Fig. 6.—Diagrammatic Plan and Section of Tonduron (The Spire).

(e) *Present Changes.*—There are no indications of any oscillations or earth-movements in the present period. The Warrumbungle Mountains abound in poised rocks so delicately balanced that the least earth-tremor would cast them down. The well-known Bottle Rock, at Timor Rock, in itself shows that there has been no earth-tremor for thousands of years.

At present we have only the agency of erosion tending steadily by means of sand blast (wind) action, rainfall, etc., to reduce the mountains to the level of the western plains.

(f) *Remarks.*— The peneplain which developed in early Tertiary or late Cretaceous times, before the commencement of volcanic activity, may have been shaped by arid agencies like those prevailing at present. However, evidence in favour of this supposition is weak, and only of a negative character, consisting in the fact that we find no marine or estuarine fossils of Cretaceo-Eocene age anywhere within a very large area, such as we would expect on submerged parts of a true peneplain.

The slight partial dissection of this peneplain which preceded the phonolitic series of eruptions may, if the peneplain were of arid origin, have been due either to an uplift caused by intrusion of sills and laccolites, or by the development of an exterior drainage leading to a renewal of erosion.

The most puzzling problem met with in the field was that of the relative age of the light-coloured and dark-coloured trachytes. The structure at Timor Rock, which I have already discussed, and that observed at Paddy's Rock in the Naman Ledges opposite Black Mountain, where we have a mass of grey arfvedsonite trachyte surrounded by a narrow rim of tilted sandstone around which there are undisturbed flows of dark trachyte, may be explained in two ways. The neck of arfvedsonite trachyte may be imagined to be a plug which has filled the vent through which the ægirine trachyte rose and flowed over the country; or it may be imagined to be an earlier mamelon or neck surrounded by later flows of more basic rock. I have, however, nowhere seen arfvedsonite trachyte or its tuffs overlying the more basic rock in a flow or sheet. It reaches higher elevations, but either overlies sandstone or extends down to unknown depths. The more basic trachytes, however, have been noticed in numerous places capping the arfvedsonite trachytes in flows and sheets, as at Goat Mountain near Tannabar (Fig.7), Mt. Caraghnan and Uargon Creek, etc. *I have therefore come to the conclusion that the dark trachytes are the newest,* and that many of the ridges of

this rock represent old valleys which were filled with it in th
volcanic period. The old ridges, consisting of softer sandston
have now become valleys.

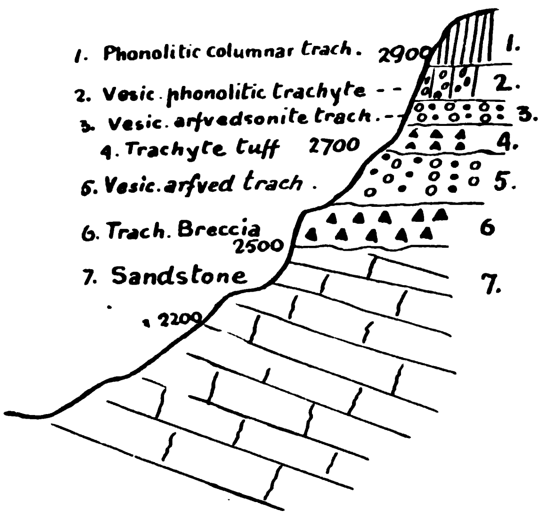

Fig. 7.—Section across Uargon Creek from Black Mountain to Naman Ledges.

The arfvedsonite trachytes have in most cases been neck
injected into tuff cones. It is easy to understand that late
erosion would find the soft tuff beds more subject to attack tha
the hard ægirine trachytes around. Consequently many plug
(or mamelons of originally viscous rock) stand now in valley
their inaccessible walls forming a striking feature.

This view is borne out by the present structure of Tonduro
(The Spire), which consists of a central plug of massive trachy
dolerite, and a number of high hills surrounding it, two of whic
(on the east and west respectively) attain mountain-like dimen
sions. These hills are remnants of the old crater-ring, and tu
and lava cone. The original mountain was built up of alternat
layers of tuff and lava, with a plug of lava in the core. By th
action of meteoric waters working along the soft tuff and brecci

beds, the cone is being destroyed, all but the central plug. In the same way have most of the steep-sided monoliths been formed.

5. Springs and Artesian Water.

(a) *Springs.*—The fact that powerful springs with a perennial flow often occur on the summits of the highest mountains and very seldom in the valleys, has been the cause of much astonishment and speculation. I have heard the problem discussed by men of every occupation, from tramp to squatter, and from stockman to doctor.

Near the summit of Mount Terra Terra, at an altitude of 3,500 feet, I saw a powerful spring, which, during the drought, gave a permanent flow of water, and was the saving of much stock. Near the summit of Tenandra Gap two great springs originate at an altitude of more than 2,500 feet, and feed the heads of Wombalong and Belar Creeks. Below Siding Spring Mountain, on the south side at an altitude of about 3,000 feet, is the large and permanent Siding Spring; and on the northern side of the same mountain, at the same altitude, is another great spring, the Boonoo Spring I believe they call it. Then we have Wheoh Springs, Yarragrin Springs, Bulleamble Springs, and many others in the Warrumbungles.

Springs at the bases of mountains may be due to meteoric waters which have accumulated in wet seasons, and which escape gradually. Such springs would, however, not be permanent. They would weaken appreciably in a prolonged drought, and would show an increased flow in wet seasons. The Warrumbungle Springs, according to information received from numerous local station-owners and stockmen, show an increased flow in drought times, and a diminished one in wet seasons; but they never disappear entirely except to reappear close by. The waters are, therefore, of deep-seated origin.

The causes advanced in text-books to account for springs are (1) steam-pressure, (2) gas-pressure, (3) hydrostatic pressure, (4) pressure of overlying rocks.

(1) The springs show no evidence of being caused by stea pressure, for none of them are warm; and volcanic activity h long been extinct in the region.

(2) Gas-pressure can hardly account for them in a primary wa

(3) Hydrostatic pressure cannot explain the phenomenon, f we get permanent springs on very high summits. They cann be connected with the artesian system, inasmuch as they a above the artesian intake beds.

(4) Pressure of overlying rocks is a plausible explanation some cases where the springs issue from sandstone beds unde lying an igneous mass; but the increased flow in drought tim and the occurrence of springs on volcanic summits are fac which cannot be thus explained.

It seems to me that several of the above causes are in oper tion, but they are not the primary cause. The primary cause these remarkable elevated springs is *rock-decay*. It is a we known fact that most rocks contain, included in them, sever times their own volume of gas, chiefly carbon dioxide a hydrogen, occluded in minute, ultramicroscopic cavities. In t same way they contain water. Decomposition liberates the substances; and in this way the gas-pressure necessary to for up deep-seated waters is produced.

In rock-formations like those of the Warrumbungles, roc decay is particularly likely to produce great gas-pressure, ina much as the elements calcium, magnesium, and iron are n present in large quantities for the liberated carbonic acid combine with. The most abundant rocks of the region a rather acid trachytes, highly alkaline and very low in lime, an highly siliceous sandstones and conglomerates. The latter a derived from older granitic rocks, and the quartz-veins a therefore, in all probability, studded with gas-pores. Most the gas produced in disintegration of the rock must therefor escape.

In a prolonged drought joint-cracks widen, giving increase facilities for the atmospheric air to penetrate into the rock

This accelerates decomposition, hence increases gas-pressure, and produces a strong flow from deep-seated sources. This flow is the more powerful from the fact that the widening of joint-cracks and fissures has lessened resistance.

In 1902, springs were particularly active in this region. Personally I am inclined to believe that even the cause suggested above is inadequate to explain this, and that there was, as well, a great cosmic cause at work, the same which produced the violent volcanic activity in other parts of the world. Perhaps some such cause was, during the drought, causing slight folding; and hence increased rock-pressure in these parts.

It is interesting to note that in 1902, when the Namoi had become a series of waterholes, powerful springs broke out in the bed of the river in several places, causing it to flow for miles. In the same year remarkable cracks, big enough to swallow a cart, opened near Trangie, not far from Dubbo, quite suddenly, without any shocks of earthquake being felt, and gradually closed up again. These were in the Black Soil Plains, and may therefore have been due to desiccation; but I am informed that the occurrence was sudden. May it not have been caused by an earth-movement not of sufficient violence to produce appreciable shocks at a distance, and not felt locally on account of the thick blanket of loose soils on the plains (*cp.* the cracks formed in the Cachar Earthquake; see Suess, 'La Face de la Terre,' Ch. i.)?

(b) *Artesian Water.*—The following facts have been elicited by conversation with local inhabitants and by personal observation:

(1) Most of the Warrumbungle streams flow perennially in the mountains, but cease to flow on reaching the plains.

(2) They are supplied by springs at an altitude of from 2,500 to 3,000 feet or more.

(3) They cease to flow at an altitude of about 1,000 to 1,500 west and north of the Warrumbungles.

(4) Many continue to flow at a depth in the sand in their beds, or in billabongs filled with sand, for some distance, but more

disappear altogether. In the Pilliga Scrub it is generally usele
to sink for water in or near a creek bed.

(5) Many of the wells and bores sunk in the district, at al
tudes of between 1,000 and 1,500 feet, strike water which ris
to a constant level, and gives a good pumping supply but do
not overflow. This is the case at the Goorianawa bore and
many wells near Bugaldi.

The lower the altitude at which the well is sunk, the deep
one has to dig for water, and the higher it rises in the well.

These wells which maintain a constant level are evident
sunk in artesian or subartesian strata near the intake.

At still lower altitudes artesian water has been obtained
sinking deeper, and it overflows at the surface, as at the Kal
Bore and Tenandra Bore.

(6) In places on Bugaldi Creek a trickle of water has be
obtained a few feet down. On sinking deeper, into soft san
stones, all the water has been absorbed, and no new supply h
been obtained.

From these considerations we may deduce the followi
conclusions:—

(1) The Warrumbungle streams are supplied by mounta
springs.

(2) The Artesian Intake Beds of the Triassic system outcr
at a level of from 1,500 to 1,000 feet to the north-west and we
of the Warrumbungles. Hence streams disappear at this lev
a feature which is partly brought about by the aridity of t
plains.

(3) Bores in the intake beds give a permanent pumping supp
but no overflow.

(4) A well in Triassic Sandstone may give a permanent pum
ing supply if cut through a pervious stratum into an underlyi
impervious one. On deepening it, one may cut into a second an
lower pervious layer, and the well will dry up again.

(5) East, north-east, and south-east of the Warrumbungles, t
formations are Permo-Carboniferous and Lower Trias, therefo

non-artesian. North-west, west and south-west the formations are mainly artesian, Upper Triassic, strata.*

For statistics concerning the output of the artesian bores near the Warrumbungle area, see Allan's paper.†

6. Diatomaceous Earths and other Minerals of Commercial Value.

(a) *Diatomaceous Earths.*—There are numerous deposits of this mineral in the Warrumbungles. Professor David described one occurrence at Wandiallabah Creek.‡ Here the earths are associated with trachytic (sanidine) tuffs.

Similar deposits in association with tuffs containing *Cinnamomum Leichhardtii*, *Endiandra præpubens* § and other leaf-remains occur at Gowang not more than half a mile from the station house at Keewong (or Gowang) Creek, and also on smaller tributaries of this creek and of Bianaway Creek. These last-named deposits are, however, thin and valueless.

A very thick deposit of good diatomaceous earth occurs on Chalk Mountain near Bugaldi. Its thickness is six feet or more, and it is interbedded with basic tuffs below which there is a sheet of phonolitic trachyte and above a sheet of vesicular basalt.

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* I am pleased to find that Mr. Pittman has also arrived at the conclusion that the trachytes in the west of the Warrumbungles overlie the Triassic intake beds of the artesian system. Mr. Pittman classes these rocks as Hawkesbury (Records Geol. Survey N. S. Wales, Vol. viii. p.187). In my Preliminary Note I called them Trias-Jura simply on account of lithological resemblance to the Trias-Jura rocks of South Queensland. I do not think any very definite evidence of age has so far been obtained, except that they cap the Permo-Carboniferous unconformably, and are of fairly late Triassic age. They also seem to me to merge into the Cretaceous to the north-west of the Warrumbungles without any unconformity, but this point is doubtful. The section of Tooraweanah Mountain in Mr. Pittman's paper is typical of sections met with in numerous places along Uargon Creek, Wandiallabah Creek, and at Gowang.

† Allan, P., "The Drought Antidote for the North-West, N. S. Wales," Proc. Sydney University Engineering Society, Vol. xi., 10th October, 1906.

‡ These Proceedings, 1896, p 264.

§ Deane, H., Records Geol. Surv. N. S. Wales, Vol. viii. p.191.

This deposit occurs about 650 feet up the mountain side at elevation of about 2,000 feet above sea-level; it apparen extends under the entire basaltic summit of the mounta outcropping on all sides.

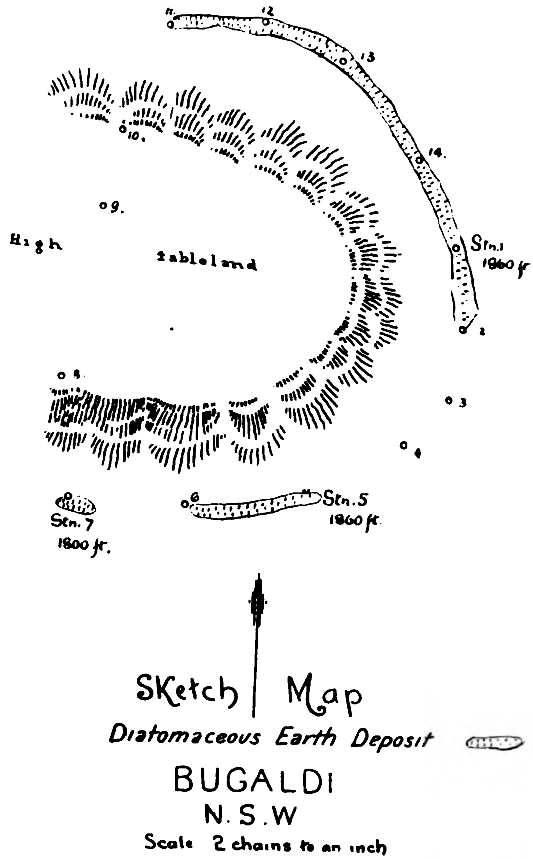

Fig.8.—Sketch Map Diatomaceous Earth Deposits, Bugaldi, N.S.W. Scale, 2 chains to an inch (reduced by ½ approximately).

I have plotted the diatomaceous earths of Chalk Mountain the accompanying figure (Fig.8).

There are numerous other similar deposits in the vicinity of Bugaldi on other hills and also in some of the valleys.

On Paddy McCulloch Mountain near Yarragrin Springs, a similar deposit occurs at about the same altitude in similar associations.

Besides tuffs, petrified wood, petrified leaves and twigs, opal, silicified breccia and chalcedony are commonly associated with these deposits. From the associations we may judge that the diatomaceous earth deposits were formed in hot lakes and siliceous hot springs situated either in the craters or close to them.

Mr. E. J. Goddard has kindly examined the diatomaceous earths collected by me (a) at Wandiallabah Creek, (b) at Chalk Mountain, (c) at Paddy McCulloch, and finds that the material from each locality consists mainly of the common variety, Melosira. He writes:—"The earth collected from the locality of Chalk Mountain consists of the frustules of several species of Melosira allied to *Melosira crenulata* and *M. granulata*, both of which are well-marked European freshwater forms, and no doubt occur among our, so far poorly examined, diatomaceous flora at the present day. The genus Melosira is the characteristic organism of diatomaceous earths in New South Wales. In the diatomaceous earth deposit of Chalk Mountain the forms present are much larger than those from Wandiallabah Creek. Spicules of the freshwater sponge, Spongilla, are also present, but are by no means abundant as in the Wandiallabah Creek deposit."

Addendum.—In the trachyte tuffs of Gowang I have met with leaves or fragments of leaves belonging to the species *Cinnamomum Leichhardtii* Ettingsh., *Endiandra præpubens* Deane, *Anopterus Pittmani* Deane, and *Cryptocarya præobovata* Deane.

(b) *Opal.*—Numerous seams of common opal, chalcedony, and allied forms of silica occur in the trachytes and associated tuffs. They are generally accompanied by silicified breccias, and petrified wood; and are probably the result of hot-spring action. I believe that there is every likelihood of good opal being found in some

parts of the mountains, especially at the head of the Castlereagh, Wandiallabah Creek and Uargon Creek.*

(c) *Coal and Ironstone.*—I have seen specimens of good coal from a well near Croxon's, a few miles south of Coonabarabran. Whether it is of Permo-Carboniferous or Triassic age I do not know, but this part of the country appears to me to be Triassic. The Geological Survey Map has it Permo-Carboniferous. It is quite possible that payable coal seams may be met with.

It is of some economic interest too that there are throughout the area many ironstone beds in the sandstones. Some of these are so rich in iron that they will probably pay to work when the railway system reaches the district and workable coal seams are found.

B. Petrology.

Only volcanic rocks were of sufficient importance for the purpose of my research to be given special mention in this part.

In the present paper, as in my previous reports on the volcanic rocks of East Moreton, I have purposely avoided making microscopic measurements, by the Rosiwal method, of the amounts of different minerals in the rocks examined. Such determinations have (according to my experience in the study of the rocks of Prospect) great value when the rocks studied are coarse and even-grained, and consist essentially of easily recognised minerals. Then it is possible, by Rosiwal measurements alone, to obtain a very good idea of the chemical composition of the rocks. However, recent researches especially have shown that even in these ideal cases the method is inexact.

The rocks discussed in this paper are uneven- and fine-grained, and porphyritic. Most have a very fine base. It is therefore often impossible, without the very greatest expenditure of time and patience, to decide the nature of each grain. The results

* I have seen some very good fair-sized pieces of precious opal obtained at the head of the Castlereagh River near Timor, and numerous small pieces, the size of pinheads, obtained in vesicular trachyte in all parts of the Warrumbungles, and especially from the localities mentioned above.

arrived at are subject to doubt and uncertainty. The method in fact becomes painfully laborious and very inexact. When a knowledge of the composition of a rock has been desirable, I have therefore made a complete chemical analysis.

In my opinion microscopic study and chemical analysis are both equally essential for the correct description of a new rock. The former reveals, as accessories, minute crystals of fluor, apatite, etc., whose presence indicate traces of F, P_2O_5, etc., which might easily be overlooked in a chemical analysis. The latter, however, brings out clearly so many facts regarding the affinities of the rock that it cannot be dispensed with. The resemblance between the pantellarites and the comendites of the Glass House Mountains, and the trachytes of the Warrumbungle and Nandewar Mountains (*e.g.*, W. 16, N. 30, N. 59) is so close that a chemical analysis is essential to feel sure that there is a difference at all.

The Warrumbungle rocks may be conveniently classified under the following general headings:—

(a) Arfvedsonite Trachytes, Comendites and Pantellarites, light grey or bluish-grey in colour.

(b) Dark Ægirine Trachytes, Phonolitic Trachytes and Phonolites.

(c) Trachydolerites.

(d) Andesitic Rocks and Basalts.

The mineral contents of the first of these two divisions include felspars, soda-hornblendes, ægirine, ægirine-acmite, felspathoids like nosean and pseudoleucite, quartz (rare), decomposition-products, and apatite (extremely rare).

The felspar occurs with three different habits—the *orthophyric*, as in the Scabby Rock trachyte; the *prismatic*, as in Timor Rock trachyte; and the *tabular*, as in the silky trachytes of Gibb's Gap, etc., and the phenocrysts in the dark phonolitic trachytes. The prismatic habit is the commonest, being developed in the majority of the felspars of most of the rocks of these divisions. Tabular felspars are also very common. The orthophyric felspars are confined to the old plugs or necks. The prismatic type occurs both in the trachytes of necks and sheets or flows. The tabular

type seems to predominate in the dykes, but occurs also in other rocks.

Orthophyric Felspars.—The felspar in the Scabby Rock specimens has the orthophyric tendency, although it is not quite isometric. The crystals seem to be usually enclosed by three sets of faces *c* (001), *y* ($\bar{2}01$) and *b* (010). Sometimes *x* ($\bar{1}01$) and *a* (100) are present. In some crystals the angles, as measured, show that the faces *m* (110) have developed to the exclusion of *b* and *y*.

Carlsbad twinning is not frequent, but Baveno twins in doublets and fourlings are common. Manebach twinning is rare.

At first sight this orthophyric felspar seems to be a water-clear sanidine, but on closer examination with high power a fine striation is noticed, in some sections both lengthwise and crosswise, giving a fine meshed appearance. Some crystals have an isometric core of unstriated felspar, probably true sanidine. The striations are due to microscopic twinning on the albite and pericline laws. The outermost zone is frequently pure albite. The felspars are therefore composed essentially of a cryptoperthitic intergrowth of orthoclase and albite or soda-microcline, occasionally with a core of sanidine and a rim of albite; the main bulk is therefore anorthoclase or microcline cryptoperthite.

The refractive index of all the crystals is lower than that of canada balsam. The optic sign is negative ($Bx_a = \mathfrak{a}$): the interference figure is, however, nearly uniaxial, and occasionally crystals occur which are positive in sign (albite): $\mathfrak{a}$ lies near a' and $\mathfrak{b} = c'$. The crystals are somewhat elongated along the *a* axis, so that sections parallel to *a* are square, and sections parallel to *b* and *c* are somewhat elongated parallelograms. Extinction is usually straight or nearly so in the direction of elongation, but of a shadowy nature in most cases, due to ultra-microscopic twinning. The extinction of the border zone usually varies slightly from that of the interior, the angle increasing from the interior outwards.

Prismatic Felspars.—The prismatic (lath-shaped) felspars so abundant in the other soda-trachytes of the area are much

more fine-grained, so that it has not been found possible to determine them with accuracy. However, they agree with the orthophyric type in having the $\mathfrak{a}$ in the direction of greatest elongation, and in the extinction angle ($\mathfrak{c}$: a) in that direction being very slight (0°-5°). Carlsbad twinning is the commonest variety of twinning. Probably this felspar is also anorthoclase. It is the most abundant mineral both in the ægirine trachytes and soda-amphibole trachytes, and occurs as well in the trachydolerites.

Tabular Felspar.—This variety constitutes most of the phenocrysts in all the trachytes. It is tabular parallel to *c*. In other respects the properties are similar to those already described for the felspar of prismatic habit.

Inclusions of a black titanium mineral, pseudobrookite (?) or rutile (?), occur sparingly in the felspar phenocrysts.

Soda-amphibole.—This is scattered about throughout the rocks, bearing it in irregular fragments, few of which are large enough to give any indication of cleavage. In a few rock-types the grains are united into dendritic (poikilitic) aggregates. Sometimes the hornblende occurs in the form of *very dark*, *blue-black*, rod-shaped crystals and irregular grains. The absorption is greatest in the direction of the length of the rods, just as is the case in the prismatic riebeckites of the rocks of Mt. Conowrin in the Glass House Mountains, and Mt. Jellore near Mittagong.*

In the more decomposed specimens the grains and rods are replaced by a reddish-brown nonpleochroic mineral (*ferrite*).

In sections showing the two cleavages (at 56°), that is, perpendicular to the *c* axis, the colour changes from deep indigo-blue to blue-black, opaque, on rotating the stage. In sections parallel to the face *a* the pleochroism is from deep blue to greenish-blue, and parallel to the face *b* from greenish-blue to yellowish-green. The extinction angle is about 14° (probably *c* : $\mathfrak{a}$).

* Taylor & Mawson, 'Geology of Mittagong,' Journ. Proc. Roy. Soc. N. S. Wales, Vol. xxxvii.

Probably the mineral is a variety of arfvedsonite. It commenced to crystallise after the larger felspars (felspar phenocrysts) had formed, and continued to crystallise until shortly before the last felspar of the base had consolidated. Hence we find felspar phenocrysts often enveloped by soda-amphibole and dendritic intergrowths of felspar and hornblende of the base.

This protraction of the period of crystallisation of the arfvedsonite was undoubtedly due to the action of mineralising vapours containing F,Cl,ZrO_2 and TiO_2.

Ægirine-augite.—In acicular crystals this is a very abundant constituent of many of the trachytes, particularly of the dark and phonolitic varieties. It is the sole ferromagnesian constituent of some rocks, but is associated with soda-amphibole in some, and with other pyroxenic minerals and olivine in the trachydolerites. It varies from highly pleochroic ægirine to almost nonpleochroic ægirine-augite. The latter is the dominant variety in the dark green trachytes and trachyandesites (W.1 Timor Ledges, W.117 Naman Ledges, and W.113 Tooraweanah Mountain, etc.). In these rocks it compensates with a selenite plate in a direction across the length, a being considerably removed from crystallographic c'; the extinction angle is mostly oblique at angles from 15°-30°; occasionally straight; the pleochroism is weak, in colours from yellowish-green to grass-green (with an occasional tinge of blue). The double refraction (γ-α) is about 0·030.

True ægirine and acmite are not well represented, but in most slides there are some crystals which can be referred to these types.

Felspathoids.—The felspathoid minerals identified in the trachytes are *nosean* and *pseudoleucite*. The chemical analyses prove that nepheline must also be widely distributed in the more basic types, although it was not at first noticed under the microscope. Staining tests confirm its presence. A more detailed description of these minerals will be given in the petrological descriptions of the slides in which they occur.

In the nosean and pseudoleucite phonolites the soda-amphibole tends to cluster round the felspathoid minerals. This seems to indicate that mineralisers abstracted SiO_2 and Na_2O from the felspar molecules, and at the same time added SO_3; the Na_2O they deposited in the ægirine-augite molecules with ZrO_2, TiO_2, F and Cl to form arfvedsonite; and the SiO_2 passed off as fluoride.

The other minerals sometimes, but not invariably, present in the trachytes comprise magnetite in primary idiomorphic grains, a very dull black or brownish-black mineral, probably pseudobrookite or rutile, minute zircon needles and more rarely minute stunted rods apparently apatite.

The order of consolidation generally followed was as follows:—

1. Accessories (magnetite, zircon,
   apatite, pseudobrookite (?), etc.)
2. Felspar
   (a) Orthoclase (sanidine)
   (b) Albite
3. Ægirine-augite
4. Soda-amphiboles

Nosean, when present, crystallised out early, practically simultaneously with the felspar phenocrysts; nepheline, when present, was one of the very last substances to consolidate.

This order of consolidation I will hereafter refer to as the *normal* order for these trachytes.

W.215. Loc: Scabby Rock. (Plate xxx., fig.3).

1. Handspecimen: this is a light bluish-grey fine-grained rock which bears close resemblance to the Glass House Mountain comendites in handspecimen.

2. In microscopic texture it may be described as hypocrystalline, with a glassy interstitial matter cementing even-sized grains of the constituent minerals. The fabric is almost orthophyric.

3. Composition: the main constituent is *felspar*, most of which occurs in elongated prismatic and isometric grains. As already mentioned in the introductory notes on the minerals, it consists of microline microperthite (anorthoclase). Some of the crystals

have a core of sanidine and a rim of albite. Next in point of amount is the glassy base in which the felspars lie. It has a greenish colour, and has partly devitrified into a doubly refracting substance, probably a chloritoid. This glass probably has the composition of ægirine-augite. Soda-amphibole is present in minute, highly pleochroic, blue-black and green fragments, too small and ragged for exact determination.

4. Order of consolidation: the felspar had almost finished to crystallise out before the ferriferous minerals commenced to crystallise.

5. Name: Hypohyaline and orthophyric "*Anorthoclase-Arfvedsonite Trachyte*" near Orthophyre.

W.45. Loc.: Scabby Rock.

This rock resembles W.215, both in megascopic and microscopic characters. The main difference between them lies in the relative proportions of glass and arfvedsonite. In W.45 the soda-amphibole greatly exceeds the glass in amount. This rock has therefore crystallised more slowly than W.215.

W.50. Loc.: Scabby Rock.

1. Handspecimen: this rock has a grey colour; it is uneven-grained, and is readily seen to consist of heterogeneous materials.

2. Microscopic texture typical of a pyroclastic rock, tuff or breccia.

3. Composition: the main constituent is glass in peculiar boomerang-shaped and dumb-bell-shaped needles. Imbedded in the meshes of this glassy matrix lie fragments of quartz, probably derived from the surrounding sandstones, and also fragments of magnetite, felspar, and soda-amphibole crystals. The structure and nature of the constituents prove the rock to be a tuff.

4. Name: Hypohyaline Soda-trachyte Tuff.

W.39. Loc.: Timor Rock, near the "Bottle Rock."

1. Handspecimen dark greenish-grey in colour, and rather fine-grained.

2. Microscopic texture: holocrystalline, with even-grained crystals cemented with a fine, even-grained, microcrystalline base; fabric trachytic.

3. Composition: felspar forms upwards of 95 % of the mass; it consists of sanidine-anorthoclase in lath-shaped crystals, in the interstices between which the other minerals of the rock are found. The most abundant soda-amphibole present is of the type already described. There is also present in larger ragged grains a small amount of a brownish soda-amphibole, highly pleochroic in colours from a deep brownish-black to light brown, purple, and even dark green. It is commonly surrounded by a rim of blue amphibole. It is probably one of the highly titaniferous amphiboles of the cossyrite family. Frequently it occurs in optically continuous aggregates enclosing felspar in a poikilitic manner. It also seems to have affinities with katophorite. A minute quantity of interstitial ægirine is present; sometimes it is gathered round arfvedsonite crystals.

4. Order of consolidation: felspar commenced to crystallise before the other minerals. The ferriferous minerals crystallised simultaneously with the last of the felspar.

5. Name: Trachytic Soda-Trachyte. Magmatic name, Nordmakose (see Analysis W.38).

Note.—The brown pleochroic amphibole mentioned above occurs in many of the rocks of this area and the Nandewar Mountains. Occasionally it is seen to shade off into clear reddish-brown non-pleochroic ferrite, a substance which in many rocks replaces it. At first I was under the impression that the rocks containing ferrite and hæmatite were altered by weathering, but a closer examination, aided by the chemical analyses, has convinced me that the alteration is in most cases due to mineralising vapours, and took place in the period of volcanic extravasation and of the cooling of the magma. Not only do we find all gradations from arfvedsonite to ferrite (including the brown pleochroic amphiboles) in the same rocks, but the felspars are quite fresh in many rocks in which ferrite is the predominant coloured constituent, and decomposition-products are rare and

the analyses do not show any notable excess of carbon dioxide or combined water above what we find in the arfvedsonite rocks (compare N.59A, an arfvedsonite rock, and N.55, a ferrite rock). The two kinds of trachyte frequently occur close together with a sharp line of demarcation between them but exposed to exactly the same weather-agencies and equally resisting to the blows of a hammer. From these facts I conclude that vapours containing HF and HCl have wholly or partly decomposed the arfvedsonite molecule subsequent to its formation, at the same time oxidising the FeO in it to Fe_2O_3, and removing the TiO_2, Na_2O and ZrO_2, redepositing them elsewhere in the rock as rutile and zircon; and a later cycle of activities restored in part these constituents, forming a rim of arfvedsonite, or perhaps more frequently the the ingress of vapours took place before the complete consolidation of the magma, and, as soon as they re-escaped, crystallisation proceeded in the normal way.

In a similar way the frequent occurrence of an envelope of ægirine round soda-hornblende, or of soda-hornblende round ægirine, may be explained. The former is probably due to the exhaustion of the mineralising vapours present in the first period of consolidation, the latter to the introduction of mineralisers after crystallisation had commenced and gone on for some time without their aid.

W.16. Loc.: base of Timor Rock.

1. Handspecimen grey in colour with bluish-black specks, giving the whole rock a bluish-grey colour.

2. Texture: like W.38, but hypocrystalline, containing a yellowish interstitial glass which gelatinises with acid and stains with malachite green. It may contain cryptocrystalline nepheline.

3. Composition: felspar similar to that in W.38 is the chief constituent. Brown amphibole and ferrite are almost wholly wanting. The blue amphibole occurs in moss-like aggregates. Ægirine is almost absent. A little limonite occurs as a decomposition-product. Round some of the felspar phenocrysts there is an isotropic white mineral which may be slightly decomposed nepheline.

4. The normal order of consolidation for these rocks was followed.

5. Name: Trachytic Soda-Trachyte. Magmatic name, Phlegrose (*cp.* Tables i. and ii.).

W.17. Loc.: Timor Rock near base. (Plate xxx., figs. 1 and 2).

1. Handspecimen a bluish-grey even-grained rock like the preceding.

2. Texture hypocrystalline and even-grained, with trachytic fabric.

3. Composition: felspar forms about 90% of the rock; it occurs in laths, most of which exhibit Carlsbad twinning, crosscracks, and other common characteristics of sanidine; but the refractive index is almost identical with that of canada balsam, so that the mineral is probably anorthoclase. There is also present a little oligoclase in laths showing albite twinning and straight extinction. Albite also occurs. The blue-green soda-amphibole is next in importance. It occurs scattered throughout the rock in minute stunted rods and elongated grains. The pleochroism colours are deep blue, greenish-blue, and greenish-yellow. Abundant inclusions of varying shapes and sizes occur. They appear to be chert fragments brought up from a depth by the lava. The soda-amphibole has aggregated round these fragments. A little interstitial quartz occurs. It was the last mineral to crystallise out. A little yellow interstitial glass is also present.

4. Order of consolidation normal.

5. Name: Trachytic Soda-Trachyte. Magmatic name, Phlegrose (see Analysis W.16).

W.114. Loc.: Paddy's Rock, Naman Range.

1. Handspecimen greenish-grey, mottled; like some of the Glass House Mountain comendites in appearance.

2. Texture: holocrystalline, even-grained, with trachytic fabric.

3. Constituents: lath-shaped anorthoclase felspars, moss-like aggregates of minute prismatic crystals of soda hornblende, interstitial ægirine, and a little interstitial isotropic material, probably a felspathoid.

4. Name: Trachytic Soda-Trachyte.

W.109. Loc.: Gibb's Gap, near Naman. (Plate xxx., fig.4).

1. Handspecimen shining, silky, dark greenish-grey and vesicular.

2. Microscopic texture: holocrystalline, microcrystalline, and even-grained base, with trachytic fabric and flow-structure, and with occasional sanidine phenocrysts.

3. Composition: the essential constituent is felspar (soda-sanidine) of prismatic habit, sometimes tabular. Ægirine-augite and blue soda-hornblende (arfvedsonite) are present in about equal proportions. The former occurs in grains interstitially; the latter in ragged grains exhibiting the characteristic pleochroism in blue, green and yellowish-green colours. A few dark opaque grains of what is probably a titanium mineral (*e.g.*, pseudobrookite ?) are also present.

4. Name: Vesicular Soda-Trachyte.

The rocks so far described, W.215, W.45, W.50, W.39, W.16, W.17, W.114, and W.109, exhibit close petrological and mineralogical affinity, though coming from different parts of the Warrumbungle area. They all come from plugs outstanding like monoliths, with precipitous walls; and such structures are almost universally composed of this rock-type.

W.222. Loc.: Bingy Grumble Mountain, summit. (Plate xxxi., figs.7-8).

1. Handspecimen dark grey, with white specks, and with a greasy lustre.

2. Texture holocrystalline, fine and uneven-grained, with trachytic fabric.

3. Composition: the main constituents are albite, pseudoleucite, nosean, and analcite; with ægirine, arfvedsonite, and, in smaller amount, a highly pleochroic, brownish-black amphibole in notable quantity and also in minute amount, nepheline, and augite-acmite, the last of which is colourless and has a double refraction of 0·040. The bulk of the felspar exhibits lath-shaped sections. Only Carlsbad twinning is common. Albite twinning is occasionally seen. The felspar is of two generations, there being lath-shaped phenocrysts of albite, and minute needles of a felspar

which has the habit of sanidine but is probably anorthoclase. The ægirine is highly pleochroic in colours ranging from grass-green to bluish-green. It has straight extinction, and compensates in the direction of the length of the needles. It occurs in bundles of acicular crystals, and commenced to crystallise early, being sometimes enclosed in felspar phenocrysts; and finished late, sometimes being seen enveloping arfvedsonite (*cp.* Note on p.594). The arfvedsonite occurs in characteristic moss-shaped aggregates which crystallised simultaneously with the felspar of the base. The pseudoleucite and nosean occur in the form of idiomorphic phenocrysts giving square, hexagonal, and polygonal sections, but rarely showing cleavage. Some of the crystals are clear, but most are dusty from an abundance of inclusions. In addition there are irregular patches of an isotropic mineral which is sometimes clear and sometimes yellowish from zeolitic decomposition-products. This mineral is frequently seen in the intervals between needles of felspar arranged in radiating, pseudospherulitic manner. Probably it is analcite. The decomposition-products are kaolin, zeolites, and ferrite.

4. Order of consolidation :

i. Phenocrysts of Albite
ii. Ægirine
iii. Nosean
iv. Anorthoclase
v. Arfvedsonite
vi. Katophorite (?)
vii. Augite Acmite
viii. Analcite (?)

5. Name : Trachytic Nosean-Analcite-Phonolite. Magmatic name, Nordmarkose (see Analysis W.222).

6. Chemical Notes : all the patches referred to the felspathoid group of minerals gelatinise with acids and take stains strongly.

W.220. Loc.: Mount Bingy Grumble.

1. Handspecimen dark brownish with greasy lustre; porphyritic in phaneric phenocrysts.

2. Texture: hyalopilitic fabric; uneven in grain.

3. Composition: the constituents are acicular felspars (albite and anorthoclase), ragged grains of arfvedsonite, and an isotropic base which does not gelatinise and stain. A little magnetite is present, and also decomposition-products such as kaolin, zeolites and brown iron ores.

4. Name: Hyalopilitic Trachyte.

W.140. Loc.: Berum Buckle. (Plate xxxi., figs. 9-10).

1. Handspecimen: a dark grey mottled rock, with large phaneric phenocrysts of tabular felspar.

2. Texture: holocrystalline, with porphyritic phenocrysts in a very fine, even-grained trachytic base.

3. Composition: the felspar is of two generations, consisting of phenocrysts of sanidine (or anorthoclase?) and the anorthoclase of the base in minute needles. The usual aggregates of blue hornblende abound, as well as the same mineral in stunted rod-shaped grains. Almost isotropic phenocrysts of regular six-sided, octangular, and four-sided outlines, and of a yellowish colour are present in abundance. They show an anomalous double refraction in the centre, which is partly due to an abundance of inclusions. These phenocrysts consist of altered leucite (pseudoleucite) and nosean. The inclusions in them are, in part at least, felspar. The felspar phenocrysts also contain throughout inclusions of isotropic material, apparently leucite, and of cancrinite, whilst in the outer zone arfvedsonite is occasionally included. The soda-amphibole also tends to crowd round the isotropic phenocrysts. Ægirine-augite occurs interstitially. Accessories are zircon, rutile, etc., as inclusions.

4. Order of consolidation:

1. Zircon, Rutile, Apatite
2. Leucite (now pseudoleucite)
3. Sanidine phenocrysts
4. Nosean
5. Blue Amphibole
6. Ægirine
7. Anorthoclase base

5. Name: Trachytic Nosean-Arfvedsonite-Leucitophyre. Magmatic name, Phlegrose.

6. Chemical Note: this rock gelatinises strongly with acid and takes stains. The absence of chlorine shows that sodalite is not present, and the low percentage of SO_3 shows that the almost isotropic material which is a very abundant constituent (more than 10 % of the bulk) cannot be wholly nosean. The low CO_2 and H_2O percentages of the rock, as well as the regular outlines of the isotropic mineral, show that this cannot be a zeolite (amygdaloidal fillings). The investigation therefore indicates that it it must be pseudoleucite.

W.141. Loc.: Tenandra Gap between Caraghnan and Mount Berum Buckle.

1. Handspecimen like W.140.

2. Texture like W.140.

3. Composition: the constituents are the same as in W.140, with these differences:—the felspathoid minerals are less abundant, ægirine-augite is more abundant, exceeding soda-hornblende in amount; and the latter mineral is a brownish variety allied rather to barkevicite and cossyrite (?) than to arfvedsonite, and is scattered about in minute grains and rods. The isotropic minerals gelatinise with acids and take stains.

4. Name: Trachytic Nosean Soda-amphibole Leucitophyre.

W.138. Loc.: A ridge N.E. of Mount Berum Buckle.

1. Handspecimen a mottled, uneven-grained yet fine-grained greenish-grey rock.

2. Texture: fabric trachytic, holocrystalline, porphyritic in felspathoid.

3. Composition: the felspar consists essentially of anorthoclase in laths. Ægirine, arfvedsonite and brownish soda-amphibole are represented. A few cubes of magnetite are present.

4. Name: Trachytic Nosean-Pseudoleucite Trachyte.

Note: the last four rocks here described, viz., W.222, W.140, W.141 and W.138, are closely allied, and belong to the group of the phonolites. In the Warrumbungles this rock-type (typified

in W.140) forms a connecting link between the light arfvedsonite-trachytes like W.116, and the dark ægirine-trachytes (and phonolitic trachy-andesites) like W.1, W.22, etc. In both physical appearance and volcanic succession they are intermediate between these two groups.

W.124. Loc.: Needle Mountain.

1. Handspecimen of a greenish colour and shining lustre. It is porphyritic in shining tabular felspars.

2. Texture holocrystalline, uneven-grained, with phaneric felspar phenocrysts, and trachytic fabric of the base.

3. Composition : the constituents, in order of decreasing abundance, are felspar, ægirine-augite, ferrite, magnetite, and blue amphibole. Only felspar and ægirine-augite are represented in notable amount. The felspar phenocrysts are tabular, and show Carlsbad twinning; from their cleavage angle, low refractive index (less than canada balsam), and extinction angles they are seen to be composed of albite. They include ægirine grains. The felspar needles composing the base are probably also albite, but may be partly sanidine or anorthoclase. The ægirine-augite occurs in idiomorphic twinned phenocrysts (twinning plane parallel to *a* (100), with moderate pleochroism). The extinction angles on the cleavage in sections showing but one cleavage are moderately high. It is therefore true ægirine-augite, and occurs abundantly in minute idiomorphic grains. Magnetite and soda-amphibole occur only in very minute proportions.

4. Order of consolidation :

1. Magnetite ———
2. Ægirine ——————
3. Albite (phenocrysts) ——————
4. Felspar of base — ·—————

5. Name : Trachytic Ægirine Soda-Trachyte.

Note : this rock is interesting as showing that an absence of mineralising vapours in the soda-trachyte magma leads to the crystallising out of the ferric constituents as magnetite, ægirine and ferrite (from the excess of Fe_2O_3), and these minerals under such conditions commence to form before the felspar.

W.113. Loc.: Tooraweanah Mountains, summit.

1. Handspecimen dark greenish-grey in colour, almost aphanitic.

2. Texture holocrystalline, even- and fine-grained with pilotaxitic fabric.

3. Constituents (in order of decreasing abundance): felspar occurs in lath-shaped sections, and appears to belong to the species anorthoclase. The ægirine-augite is a somewhat strongly pleochroic variety changing from light leek-green to dark green and greenish-yellow. It occurs in needles and prismatic grains with frayed ends. Biotite in irregular fragments is present in the same proportion as ægirine-augite. As accessories we find magnetite and ferriferous decomposition-products.

4. Name: Pilotaxitic Biotite Ægirine-Trachyte.

5. Note: biotite occurs in varying, usually very minute proportions, in most of the dark-coloured trachytes in which the main femic constituent is ægirine-augite. These trachytes are closely related to and graduate into andesites.

W.117. Loc.: Naman Ledges opposite Black Mountain on Uargon Creek.

1. Handspecimen dark greenish in colour, with even fracture, silky lustre, and aphanitic grain-size.

2. Texture as in W.113.

3. In composition it differs from W.113 in that biotite is exceedingly rare; and it contains a few irregular masses of dolomite, which probably represent infilled vesicles.

Name: Pilotaxitic Ægirine Trachy-Andesite.

W.9. Loc.: Timor Ledges, Warrumbungle Range, one mile north of Timor Rock. (Plate xxx., fig.5).

1. A dark aphanitic, silky rock, with even fracture.

2. In texture like W.117.

3. Composition as in W.117, but there is no dolomite, and a little chlorite is present. The chlorite probably represents altered ægirite or glass, and occurs in almost isotropic patches with a fibrous structure.

4. Name: Pilotaxitic Ægirine Trachy-Andesite. Magmatic name, Monzonose (see Analysis W.1).

Note: this specimen is the same as W.1, which was analysed. The analysis of W.1 represents the composition of most of the great flows of trachy-andesite lava and phonolitic trachyte which followed the outbursts of true trachyte and phonolite. In these flows the iron, lime, and magnesia are higher, and the silica lower than in the trachytes. However, their high percentages of alkali and Al_2O_3 show their definite relationship to the other rocks. The trachy-andesites were tested for felspathoids with acid and staining reagents. Rocks of similar appearance from different parts of the Warrumbungles were sectioned and tested. Most resisted the reagents, but a few stained slightly in the ground-mass, and sometimes small nephilinitoid crystals took the stain. It appears therefore that most of these rocks are free from felspathoid mineral, but some contain a little interstitial nepheline. On account of their close resemblance to one another in physical, mineralogical and chemical characters and their close field-relationship, I have classed these rocks together as trachy-andesites and phonolitic trachytes.

W.127. Loc.: ridge between Berum Buckle and Belar Creek, about one mile N.E. of Berum Buckle.

1. Handspecimen not unlike Gib Syenite. It abounds in vesicles (miarolitic structure).

2. Texture holocrystalline, uneven-grained, porphyritic with trachytic fabric in the groundmass.

3. Composition: the essential constituent is orthoclase of prismatic and acicular habit (giving lath-shaped sections). The other minerals present are phenocrysts of magnetite, needles of ægirine, irregular grains of soda-amphibole and ferrite with iron-bearing decomposition-products.

4. Name: Porphyritic Soda-Trachyte.

W.135. Loc.: same as W.127. This rock is similar in every respect to the preceding.

W.121. Loc.: Mount Caraghnan, summit.

1. Handspecimen of a dark colour.

2. Texture holocrystalline, fine- and even-grained, with pilotaxitic fabric approaching panidiomorphic-granular.

3. Composition : it consists of felspar laths, and ægirine-augite in needles and stunted prisms.

4. Name : Ægirine Trachyte.

W.132. Loc.: Damnation Gully, below and north of Mount Caraghnan.

1. Handspecimen of a brick-red colour; grain-size uneven; fracture rough; lustre silky.

2. Texture as in W.127 and W.135.

3. Composition: the same minerals occur as in W.127 and and W.135, with which rocks it has close affinities. It is porphyritic in tabular and lath-shaped felspars and in magnetite. The felspar phenocrysts are albite. The other minerals represented are bluish-green highly pleochroic soda-hornblende (arfvedsonite?), hæmatite, the felspar of the base and ferric decomposition-products.

4. The hæmatite is an original constituent and crystallised immediately after the magnetite.

5. Name: Porphyritic Magnetite Soda-Trachyte.

W.125 from Damnation Gully is similar to W.132 except in that most of the phenocrysts are composed of anorthoclase showing Carlsbad twinning.

W.142. Loc.: south slope of Mount Caraghnan.

1. Handspecimen reddish when weathered, greenish-grey when fresh; lusture silky, fracture rough.

2. Texture : holocrystalline, porphyritic hence uneven-grained, with a fine-grained base composed essentially of felspar laths.

3. Composition: the felspar phenocrysts appear to be partly anorthoclase, partly albite. The felspar of the ground-mass is sanidine or anorthoclase. Biotite occurs abundantly in frag-

mentary flakes and is evidently foreign to the magma, having been snatched up in the upward passage of the lava from the strata penetrated. A little arfvedsonite, some grains of ægirine, and a few grains of magnetite are also present.

4. Name: Porphyritic Albite-Biotite Soda-Trachyte.

W.22. Loc.: Nandi Mountain, Coonabarabran. (Plate xxx., fig.6).

1. Handspecimen dark in colour, porphyritic and rather more coarse-grained than those previously described.

2. Texture: holocrystalline, fairly even-grained but for the phenocrysts: grain-size averaging less than 1 mm., hence fine; fabric panidiomorphic-granular.

3. Composition: the essential constituent is felspar of prismatic habit, giving square, rectangular, and lath-shaped sections. Twinning is on the Carlsbad law. The crystals are zoned, the interior portion being full of dark inclusions of magnetite and chlorite, the outer portions being usually clear. The felspar has usually slight extinction, but occasionally it extinguishes at low angles up to 10°. The refractive index is lower than that of canada balsam. It appears to be essentially orthoclase and anorthoclase. The mineral next in order of decreasing abundance is olivine, which occurs in partially resorbed phenocrysts showing incipient decomposition to serpentine. Ægirine-augite occurs both included in felspar and interstitially. It has the acicular habit. Magnetite occurs, primary in idiomorphic cubes as inclusions in felspar, and also interstitially in the ground-mass. Secondary magnetite in mossy aggregates is also present. Serpentine and chlorite occur sparingly as decomposition-products.

4. Order of consolidation: the felspar is of two generations, the portion abounding in inclusions having probably formed in a deep-seated magmatic reservoir. Crystallisation commenced with the olivine which is devoid of inclusions.

We therefore have the following order :—

Olivine	———
Magnetite	—————
Felspar, 1st gen.	————
Ægirine	————— —
Felspar, 2nd gen.	————

5. Name : Panidiomorphic Olivine-Trachy-Andesite (*Keratophyre* of Rosenbusch).

Note : another slide of the same specimen showed, in addition to the minerals already mentioned, an interesting brown mineral highly pleochroic in colours from deep reddish brown to yellowish-brown. It shows no trace of cleavage, but is highly corroded and full of magnetite inclusions, some of which are undoubtedly primary and most probably secondary. Fragments of it also occur adhering to the mossy magnetite aggregates. Both are probably secondary. The shape of the crystals of this brown mineral suggests hornblende or hypersthene, and the inclusions are arranged as in hypersthene. The mineral is probably *pseudobrookite* secondary after titaniferous rhombic pyroxene or hornblende.

Chemical Analysis : Specimen W.22 is in physical appearance very like W.1 (trachy-andesite), and in chemical composition these rocks are also very close. The Nandi rock is, however, richer in ferric oxide and titanic acid. The excess of the latter has combined with Fe_2O_3, and probably Na_2O and SiO_2, to give a femic mineral subsequently altered to pseudobrookite (?), leaving an excess of FeO free to combine with MgO to form olivine.

Magmatic name of W.22, Monzonose (*cp.* Tables i. and ii.).

W.32. Loc.: The Forked Mountain, near Coonabarabran.

This rock resembles W.22 both macroscopically and microscopically. However, it contains some beautiful ægirine-augite phenocrysts and fine plates of red micaceous hæmatite which is an original mineral. Acicular crystals of apatite are present.

Name : Hypidiomorphic-granular Olivine Hæmatite Trachy-Andesite or Keratophyre (Rosenbusch).

W.30. Loc.: The Forked Mountain.

In this rock the ægirine-augite phenocrysts are still more plentiful, and hæmatite less so than in W.32.

Name: Ægirine-Olivine Trachy-Andesite.

The Nandi, Forked Mountain, and other rocks from the buttes around Coonabarabran must be ranked as trachyandesites on account of their peculiar mineralogical composition. They are intermediate between the trachyandesites (and phonolitic trachytes) of Timor Ledges, Naman Ledges, etc., and the sodalite or analcite basalts of Tonduron (The Spire) and Wombalong (Mount Exmouth). They are apparently the volcanic equivalents of an essexite magma. Variations in the relative proportions of ægirine, hæmatite, olivine, and pseudobrookite (?) seem to have been controlled essentially by variations in the titanium percentage in different portions (*cp.* Analyses W.1, W.22; and petrological descriptions W.117, W.9, W.22, W.32, W.30).

Minerals of Trachyandesites, Trachydolerites and Sodalite Basalts.

The minerals contained in common by these rocks are:—

(a) Plagioclase Felspar. This mineral occurs in phenocrysts which show Carlsbad, Albite, and Pericline twinning. Its extinction angle in symmetrical sections varies from 10° to 25°. Presumably the varieties albite, oligoclase, andesite, and labradorite are all present. In the ground-mass the felspar has the form of needles, and fine laths whose refractive index is lower than that of canada balsam and whose extinction angles are very low. It is probably albite or anorthoclase.

(b) Orthoclase Felspar occurs both as fragmentary phenocrysts and as fine laths (sanidine) in the base. It is probably soda-bearing, and often graduates into albite or anorthoclase.

(c) The olivine is a clear colourless variety which occurs as highly corroded phenocrysts with serpentinous cracks. It is the chief mineral found included in the felspar phenocrysts.

(d) Several varieties of augite occur. The chief is a light brownish or copper-coloured, titaniferous, slightly pleochroic diallage. This kind is of two generations, the first occasionally

forming phenocrysts which may include olivine. The phenocrysts are quite allotriomorphic, and often bound together in such a way as to indicate that the rock is derived from the refusion of a coarsely crystalline gabbro or theralite. The second generation occurs in minute idiomorphic grains in the base, and sometimes ophitically intergrown with felspar.

Darker brown titaniferous augite and greenish varieties allied to ægirine occur in some of the rocks.

(e) Apatite is a common constituent in minute quantities, and occurs in the form of long needles often included in the felspar and augite phenocrysts.

(f) Magnetite in idiomorphic cubes and ilmenite in hexagonal plates are both very common.

(g) Sodalite or analcite with very low refractive index and completely isotropic is a common constituent. It occurs in perfectly clear but very irregular patches in the interstices between the other minerals. It stains strongly.

As inclusions, in the albite phenocrysts particularly, we find olivine, apatite, magnetite, augite, ægirite, and occasionally biotite.

An interesting point is that in these rocks the felspar phenocrysts are always corroded less than those of augite and olivine. It appears therefore that the basic nature of these rocks is due to the remelting and absorption of a gabbro, theralite or essexite by an acid alkaline magma. An acid magma would exercise greater corrosive (chemical) influence on the basic minerals of the absorbed rock than on the acid ones. The felspars would only be slightly corroded, and would rather tend to grow as the magma cooled. We should therefore expect, and actually do find, zoning common in the felspars of these basic rocks.

W.67. Loc.: Tonduron (The Spire), head of Spire Creek. (Plate xxxi., figs.5-6).

1. Handspecimen a dark bluish-black rock with splintery fracture and oily lustre.

2. Texture: holocrystalline, very uneven-grained, porphyritic with large phaneric phenocrysts, and with pilotaxitic base.

3. Composition: the plagioclase consists of phenocrysts of acid labradorite idiomorphic in outline and idiomorphic albite phenocrysts with corroded edges and numerous inclusions. Amongst the inclusions the most abundant are of augite, magnetite and olivine, but muscovite and quartz fragments also occur. The latter are evidently of extraneous origin. The second generation of felspar consists of prismatic needles of clear albite and anorthoclase. Many of the phenocrysts show Schiller structure, and zoning is very frequent, the outer portions of a crystal being the more acid. The augite is of two generations, the first being diallagic. The olivine is also of two generations. The most abundant iron ore is magnetite, which occurs chiefly in the base. Apatite is also present. A mineral of the sodalite group occurs interstitially. Less important are the following:—orthoclase phenocrysts in rare fragments; quartz fragments included in the felspar phenocrysts; talc included in labradorite, especially in the crystals showing Schiller structure, and rare flakes of muscovite which may be either primary inclusions or secondary developed by alteration. All these minerals are xenocrysts.

4. Order of consolidation:

1. Olivine
2. Felspar phenocrysts
3. Diallage
4. Apatite
5. Magnetite
6. Augite (2nd generation)
7. Albite (2nd gen. felspar)
8. Isotropic sodalite or analcite (interstitial)

Remarks: the augite of the first generation is a titaniferous (reddish) diallage, whereas that of the second generation is a light green or colourless diopside. Round the corroded felspar phenocrysts of the first generation there is frequently a deposit of laths of acid felspar arranged parallel to the original crystal. This deposit frequently encloses magnetite grains.

As shown in Plate xxxi., fig.5, this rock contains aggregates of coarse crystals of olivine, felspar, and pyroxene, not unlike inclusions of partly resorbed olivine gabbro. From this characteristic, considered in conjunction with the occurrence of the felspar of talc and muscovite (sericite ?) and of Schiller structure, and with the presence of diallagic augite and an alkaline base, the rock appears to have been formed by the crushing and partial refusion of an olivine gabbro, and the blending of the mass thus formed with an alkaline magma.

5. Name: Pilotaxitic Orthoclase (and Sodalite ?) Basalt, allied to Trachydolerite. Magmatic name, Akerose (see Tables i. & ii.).

W.201. Loc.: Mt. Exmouth, summit.

1. Handspecimen a dark bluish-black porphyritic rock with greasy lustre and splintery fracture.

2. Texture: almost holocrystalline, with very variable grain-size. The base is very fine-grained (microcrystalline) and has a hyalopilitic fabric in places, trachytic in others.

3. Constituents (in order of decreasing amount): felspar occurs in idiomorphic, only slightly corroded phenocrysts of medium labradorite, and in fine microscopic needles varying from albite to labradorite. Olivine in corroded phenocrysts. Augite rarely as very corroded, rounded phenocrysts, but abundant in minute grains throughout the base; it is a titaniferous variety. Magnetite in idiomorphic grains. A little glass is also present, as well as accessories comprising serpentine (decomposition-product), apatite and sodalite (or allied isotropic mineral).

4. Name: Porphyritic Hyalopilitic Olivine Basalt.

W.85. Loc.: Uargon Tableland, south of Black Mountain. (Plate xxxii., fig.1).

1. Handspecimen like the preceding.

2. Texture like W.67 with pilotaxitic-ophitic fabric.

3. Composition: the phenocrysts comprise felspar varying from acid labradorite to andesine; corroded olivine; augite so inter-

penetrated with felspar as to appear broken up into grains yet optically continuous over small areas. The base is microcrystalline and consists of titaniferous augite in prismatic grains; acid plagioclase (oligoclase and albite); an isotropic mineral with very low refractive index occurring in irregular patches, probably sodalite; and idiomorphic magnetite grains. The felspar phenocrysts contain inclusions of an isotropic colourless mineral (analcite from decomposition).

Name: Porphyritic Ophitic Olivine-Sodalite Basalt.

W.207. Loc.: summit of Terra-Terra.

1. Handspecimen somewhat decomposed, highly porphyritic in plagioclase (albite).

2. Texture: the base is very fine, microcrystalline, with hyalopilitic fabric.

3. Constituents (in order of decreasing amount): (a) felspar, (b) magnetite, (c) ferrite and hæmatite, (d) sodalite (or analcite), (f) glass, (g) nepheline. The felspar is essentially albite, and occurs in the base in minute laths. The red iron ore is derived from the decomposition of magnetite, though some of the hæmatite may be original. Olivine and augite are absent. The composition being essentially made up of albite and magnetite, this rock is necessarily very alkaline. I have examined specimens of a rock of the same composition collected by my brother, Mr. Thor Jensen, L.S., at Coorombin Creek, Q., near the McPherson Range.

4. Name: Nepheline-Sodalite Tephrite.

W.58. Loc.: one mile east of Gowang Station. (Plate xxxii., figs. 2-3).

1. Handspecimen coarsely porphyritic with aphanitic base and splintery fracture.

2. Texture: holocrystalline with phenocrysts exceeding 5 mm. in diameter, and a very fine microcrystalline base with pilotaxitic fabric.

3. The constituents comprise felspar, a honey-yellow mineral which seems to be meliphanite, magnetite, olivine, fine-grained augite and apatite. The felspar phenocrysts range in basicity from acid labradorite to albite. Many are zoned, the outer zone being of a very acid character. The lath-shaped felspars of the base appear to be anorthoclase. A very curious phenomenon may be observed in some parts of the base. Viewed in plane polarised light without the analyser, it looks like a pilotaxitic mass of hypidiomorphic crystallites of different minerals. Yet as soon as the analyser is put on, certain patches appear to contain a base which is optically continuous over the whole area, and these patches have definite crystalline outlines. They behave, in fact, like phenocrysts of very acid felspar (apparently anorthoclase) embracing crystallites of lime-soda felspar, meliphanite, magnetite, augite and olivine. Some of the basic felspar phenocrysts merge imperceptibly into the ground-mass. Many are deeply corroded, but do not merge into the ground-mass. The yellow mineral, provisionally termed meliphanite, is quite allotrimorphic. It is rather pleochroic from yellow to greenish-yellow. Some thin flakes are light green in colour. It crystallised last, for it commonly envelops the other minerals and occurs interstitially. The double refraction is strong and the refractive index moderate. Apatite occurs in allotriomorphic fragments. The magnetite is idiomorphic. The pyroxene consists of minute grains and laths of colourless to greenish diopside. Chlorite occurs secondary after diopside. In some sections a bluish isotropic mineral, probably haüyne, occurs interstitially.

4. Order of consolidation :

1. Felspar Phenocrysts
2. Olivine
3. Magnetite
4. Felspar
5. Meliphanite

5. Name : Pilotaxitic Meliphanite-Olivine-Basalt.

Remarks.—The curious patches of optically continuous felspar noted above and the various stages of absorption exhibited by the felspar of the first generation are matters which suggest that this rock originated by the refusion of a previously existing gabbro. The fused mass then received an addition of alkaline magmatic waters and a little alkaline lava. On the magma reaching the surface many of the phenocrysts which had survived the upward passage were now recrystallised. The recrystallisation must have taken place after the lava came to rest, otherwise the outlines of the crystals would have been lost. A kind of hydato-igneous fusion must have taken place, otherwise we cannot imagine how the magnetite was introduced, unless these crystals were rich in inclusions to begin with.

W.40. Loc.: Billy King's Creek, 2½-3 miles south of Coonabarabran. The rock forms a lava-flow.

1. Handspecimen black in colour, consisting of a dark aphanitic base containing a few felspar phenocrysts.

2. Texture: the base is very fine-grained, and has a trachytic fabric.

3. Constituents: the felspar phenocrysts consist of albite; the felspar of the base is mainly albite, but a little anorthoclase appears to be present as well. A couple of perfectly rounded phenocrysts of andesine also occur. The next constituent in order of abundance is a black dusty mineral, usually opaque, but occasionally showing slight translucency with a bluish tint. Sometimes this mineral is seen in four-sided, five-sided, or six-sided grains, but more often it is quite allotriomorphic, and occasionally the dust occurs in groupings similar to the ophitic groups of riebeckite in the trachytes. Most of it has a dull lustre and is probably a variety of emery or corundum. A few of the cubical grains consist of magnetite. It is possible that a black, opaque garnet mineral may be present as well. The felspar forms roughly 55-60 % of the bulk of the rock, the black opaque minerals 10-15 %. Next in order of abundance we have a yellow or brownish-yellow mineral in acicular prisms and

columnar grains. It shows a strong pleochroism giving reddish or brownish-yellow, wine-yellow and very pale yellow. Irregular cracks in a direction transverse to the length of the prisms sometimes occur. A cleavage, and occasionally twinning, may be noticed running in the direction of the length of the crystals. The extinction angle varies from 0° to 20°. Double refraction is strong. From these characters, the mineral, which forms about 10 % of the rock, appears to be laavenite. Next in order of abundance we have minute prisms, grains and lozenge-shaped microlites, clear colourless sphene with characteristic high refractive index and double refraction. A light greenish to colourless diopside also occurs in grains. Melilite occurs in patches and is moulded on the felspar enveloping it in an ophitic manner. It has the characteristic peg-structure. Finally we have an isotropic colourless interstitial substance which gelatinises with acid; it probably consists of leucite or analcite.

4. Order of consolidation:

1. Sphene
2. Felspar (2nd gen.)
3. Corundum (?)
4. Laavenite (?)
5. Melilite
6. Isotropic base

A little primary hæmatite is present, and crystallised out early. The felspar of the first generation was highly corroded by the magma just before the period of crystallisation. A ferromagnesian mineral (either an amphibole or pyroxene) was also originally present but was completely resorbed, and one can only trace its former presence by the existence of patches of dusty corundum and magnetite and isotropic mineral, which have the outline of hornblende phenocrysts. The orginal mineral has been completely pseudomorphosed.

The chemical composition of the rock is so extraordinary that one can only account for the amount of Fe_2O_3 by assuming that the black mineral is, in part at least, garnet. In this way the

spare SiO_2 (quartz of the norm) would also be used up and conditions for the production of leucite or analcite in the base would be brought about.

4. Name: Corundum (?) Basalt (with sphene, melilite and laavenite). Magmatic name, Monzonose.

Note: the occurrence of blue corundum in rare grains in this rock is confirmative of the Rev. J. M. Curran's theory as to the origin of our sapphires.

The rock (W.40) has many points in common with W.58, but contains no olivine.

W.64. Loc.: Tableland south of Belar Creek.

1. Handspecimen dark grey rock with rough fracture; looks like andesitic basalt.

2. Texture: holocrystalline, uneven-grained, with ophitic fabric.

3. Composition: labradorite felspar in laths, but not as phenocrysts. Only one generation is developed. Brownish, titaniferous, somewhat pleochroic augite, occasionally pierced by felspar laths. Colourless olivine in corroded phenocrysts. Magnetite in idiomorphic grains; ægirine in needles lying interstitially between felspar laths; and orthoclase also interstitial. An isotropic mineral of the noselite group, or perhaps leucite, also occurs interstitially.

4. The occurrence of ægirine and orthoclase in this rock justifies its classification as a trachy-dolerite.

5. Name: Ophitic Olivine Trachy-Dolerite.

Other specimens from other parts of the same tableland were similar macroscopically and microscopically. This rock covers a great area.

M.6. Loc.: 34-mile peg, Gunnedah-Coonabarabran Road.

This rock is a holocrystalline, fine-grained, ophitic dolerite with porphyritic olivines. It is composed of labradorite, titaniferous augite, and olivine, with magnetite and apatite as abundant minor constituents.

Name: Olivine-Dolerite.

This rock is calcic and has no relation with the alkaline series.

M.1. Loc.: Hilltop, Black Jack Coal Mine, Gunnedah.

This is a holocrystalline, medium-grained dolerite porphyritic in olivine and titaniferous augite. It contains labradorite (lath-shaped), idiomorphic phenocrysts of purplish augite, corroded olivine phenocrysts, idiomorphic grains and phenocrysts of magnetite, and interstitially analcite Apatite occurs as an accessory. The isotropic mineral darkens on heating and gelatinises with acid. It is therefore analcite, but appears to be of secondary origin in part at least.

Name: Olivine-Analcite-Dolerite.

The microscopic investigation of the rocks of the Warrumbungle Mountains brings out the following points, namely:—(1) the existence in the district of a complete series of alkaline rocks ranging from acidic comendites to basic sodalite-analcite basalts; (2) the gradation of these rocks into one another; and (3) that in the volcanic period older basic rocks were remelted at depths in various places, and, after being mixed with more acid alkaline magma, rose to the surface.

The alkaline rocks include—

(1) Riebeckite Comendites } *cp.* Anal.
(2) Pantellarites }
(3) Arfvedsonite Trachyte.
(4) Nosean-Leucite Trachytes and Phonolites.
(5) Ægirine Anorthoclase Trachydolerites and Trachytes.
(6) Albite Magnetite Basalt without olivine or augite.
(7) Sodalite and Analcite Basalts, sometimes with melilite and meliphanite (?).
(8) Garnet and Corundum-bearing Basalts, with laavenite and melilite.

A comparison of the chemical analyses with one another and with the mineralogical characters is very instructive.

TABLE I.—CHEMICAL ANALYSES OF ROCKS FROM THE WARRUMBUNGLE MOUNTAINS.

	W.67. Orthoclase-Basalt. Loc.: Tonduron or Spire.		W.40. Corundum-Basalt. Loc.: Billy King's Creek, near Coonabarabran.		W.1. Trachy-andesite. Loc.: Timor Ledges		W. 22. Trachy-andesite. Loc.: Forked Mtn.		W.222. Nosean Phonolite. Loc.: Bingy Grumble Mountain.		W.140. Pseudoleucite Nosean Phonolite Loc.: Berum Buckle Mountain.		W.16. Arfvedsonite Trachyte. Loc.: Timor Rock.	
	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.
SiO_2	51·88	0·865	48·27	0·805	58·95	0·983	58·32	0·972	60·32	1·005	62·42	1·040	65·90	1·098
Al_2O_3	14·20	0·139	18·02	0·176	17·04	0·167	18·04	0·176	18·32	0·179	17·69	0·174	16·74	0·164
Fe_2O_3 ...	3·72	0·023	12·06	0·076	2·80	0·018	3·27	0·021	3·55	0·022	2·72	0·017	1·72	0·011
FeO	6·87	0·096	0·90	0·013	4·66	0·065	4·28	0·060	1·96	0·026	2·19	0·031	1·99	0·028
MnO	0·02	} 0·001	0·03	} 0·001	0·05	} 0·001	0·06	} 0·001	0·03	} 0·001	0·08	} 0·001	0·06	} 0·001
NiO	0·04		0·04		0·01		trace		0·05		trace		0·01	
CoO	abs.	—	trace	—	abs.	—	abs.	—	trace		abs.		trace	
MgO	4·62	0·115	1·17	0·029	0·57	0·014	0·58	0·014	0·01	0·001	0·20	0·005	0·06	0·002
CaO	6·36	0·114	6·06	0·109	2·49	0·045	2·52	0·045	1·12	0·020	1·53	0·027	0·09	0·002
Na_2O	3·93	0·063	3·73	0·060	4·51	0·073	4·52	0·073	7·01	0·113	5·93	0·096	6·35	0·103
K_2O	3·27	0·035	3·33	0·035	6·39	0·068	6·21	0·066	6·25	0·067	6·29	0·067	5·77	0·062
H_2O (100°C −)	0·58	} 0·117	0·85	} 0·078	0·59	} 0·106	0·35	} 0·072	0·35	} 0·094	0·24	} 0·050	0·27	} 0·039
H_2O (100°C +)	1·44		0·52		1·28		0·95		1·31		0·69		0·43	
CO_2	0·29	0·007	0·30	0·007	0·06	0·001	—	—	trace		abs.		abs.	
TiO_2	3·54	0·044	4·87	0·061	0·76	0·009	1·25	0·015	0·25	0·003	0·35	0·005	0·25	0·003
ZrO_2	—	—	0·04	—	0·17	0·001	—	—	0·38	0·003	0·20	0·002	0·29	0·002
P_2O_5	trace	—	trace	—	abs.	—	pre.n.d.		abs.		abs.		abs.	
Cl	trace	—	trace	—	trace	—	—		abs.		—		trace	
F	—	—	0·11	0·005	abs.	—	—		—		—		0·16	0·008
SO_3	0·04	—	abs.	—	trace	—	—		0·11	0·001	0·05	0·001	abs.	
S	—*	—	abs.	—	abs.	—	—*		abs.*		abs.*		abs.*	
BaO	abs.		abs.		abs.		abs.		abs.†		abs.†		abs.†	
SrO	abs.		abs.		abs.		abs.		abs.†		abs.†		abs.†	
Li_2O	—		abs.		abs.		abs.		abs.†		abs.†		abs.†	
Sum... ..	100·80		100·30		100·38		100·35		101·02		100·58		100·09	

* No Pyrites. † Spectroscopic test only.

TABLE I.—CHEMICAL ANALYSES OF ROCKS FROM THE WARRUMBUNGLE MOUNTAINS (*continued*).

	W. 38. Arfvedsonite-Ægirine Trachyte. Loc.: Timor Rock.		W. 127. Porphyritic Soda Trachyte. Loc.: N.E. of Berum Buckle.		A. Trachyte. Loc.: Mt. Flinders, nr. Ipswich, Queensland (Analyst, H. I. Jensen).		B. Trachyte. Loc.: Parish of Dungarry, near Dubbo, N.S.W. (Analyst, B. White, Rec. Geol. Surv. N.S.W.)		C. Trachyte. Loc: The Canobles, nr. Orange, N.S.W. (Analyst, B. White, Rec. Geol. Surv. N.S.W.)		D. Trachyte. Loc.: Wantialable Ck., Warrumbungle Mts. (Analyst, J. C. H. Mingaye, Rec. Geol. Surv. N.S.W. iv. p. 116, 1895).		E. Ægirine Trachyte. Loc.: Mount Jellore, Mittagong. (Analyst, D Mawson, Journ. Roy. Soc., N.S.W., xxxvii.).	
	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.
SiO_2	63·82	1·064	60·73	1·012	60·58	1·010	67·68	1·128	72·06	1·201	74·12	1·235	66·68	1·111
Al_2O_3	17·85	0·175	18·16	0·178	18·06	0·177	13·99	0·137	13·86	0·136	12·39	0·122	14·63	0·143
Fe_2O_3	2·75	0·017	4·63	0·029	3·05	0·019	3·20	0·020	1·90	0·012	0·31	0·002	2·18	0·014
FeO	1·67	0·024	0·20	0·003	1·38	0·019	1·98	0·028	1·71	0·024	0·21	0·003	2·31	0·032
MnO	0·04		0·10		0·04		0·02		0·07		trace		0·49	0·007
NiO	abs.	—	trace	0·001	0·07	0·002	abs.	—	abs.	0·001	—		—	
CoO	abs.		trace		trace		abs.		abs.		—		—	
MgO	0·06	0·002	0·31	0·008	0·23	0·006	0·34	0·009	0·19	0·005	0·42	0·010	0·30	0·007
CaO	0·59	0·011	0·10	0·002	1·74	0·030	0·84	0·014	0·18	0·004	0·30	0·005	1·88	0·034
Na_2O	7·13	0·115	4·88	0·079	5·01	0·081	5·30	0·085	5·84	0·094	3·22	0·052	6·12	0·098
K_2O	5·51	0·059	6·21	0·066	6·87	0·073	4·87	0·052	3·69	0·039	5·07	0·054	4·02	0·043
H_2O (100°C −)	0·66	0·060	0·72		0·99	0·106	0·65	0·094	0·21	0·028	2·22	0·239	0·38	0·067
H_2O (100°C +)	0·20		1·33	0·117	0·90		1·05		0·33		2·10		0·83	
CO_2	abs.		trace		—		0·02	—	0·03	0·001	—	—	0·05	0·001
TiO_2	0·25	0·003	0·60	0·008	0·83	0·010	0·20	0·003	0·12	0·001	—		0·20	0·003
ZrO_2	—		—		—		abs.		abs.		—		trace	
P_2O_5	abs.		abs.		—		0·04		0·06		—		0·28	0·002
Cl	trace		0·03		—		trace		trace		—		0·03	
F	—		—		—		—		—		—		—	
SO_3	—		—		trace		abs.		abs.		trace		trace	
S	—*		—*		—*		abs.		abs.		—		0·05	
BaO	abs.†		—		trace		abs.		abs.		trace		nil	
SrO	abs.†		—		abs.		trace		trace				nil	
Li_2O	abs.†		—				trace		trace				trace	
Sum	100·53		98·00		99·75		100·18		100·25		100·33		100·43	

* No Pyrites. † Spectroscopic test only.

TABLE II.—NORMATIVE MINERAL COMPOSITION OF THE ROCKS OF WHICH THE ANALYSES APPEAR IN THE PREVIOUS TABLE.

W.67.
Orthoclase Sodalite Basalt.
Loc.: Tonduron or Spire.

	Per cent.
Orthoclase	19·46
Albite	33·01
Anorthite	11·40
Diopside	14·67
Hypersthene	5·05
Olivine	3·07
Magnetite	5·34
Ilmenite	6·69
Calcite	0·70
(Water)	2·02
(SO_3)	0·04
Sum	101·45

Salic Minerals	63·87
Femic "	34 82

$\frac{\text{Sal.}}{\text{Fem.}} < \frac{7}{1} > \frac{5}{3}$

i.e., Class ii. Dosalane.

$\frac{\text{Q.L.}}{\text{F.}} < \frac{1}{7}$

∴ Order 5. Germanare.

$\frac{K_2O + Na_2O}{CaO} = \frac{98}{41} < \frac{7}{5} > \frac{5}{3}$

∴ Domalkalic (Rang 2)

$\frac{K_2O}{Na_2O} = \frac{35}{63} < \frac{3}{5} > \frac{1}{7}$

∴ Subrang 4 Dosodic.

Magmatic name: Akerose.

W.40.
Corundum Basalt.
Loc.: Billy King's Creek.

	Per cent.
Quartz	3·12
Orthoclase	19·46
Albite	31·44
Anorthite	14·46
Corundum	2·96
Hypersthene	3·03
Hæmatite	12·16
Fluorite	0·16
Titanite	9·60
Ilmenite	1·82
Calcite	0·60
Water	1·37
Sum	100·18

Salic Minerals	71·44
Fem. "	26·77

∴ $\frac{\text{Sal.}}{\text{Fem.}} < \frac{7}{1} > \frac{5}{3}$

i.e., Class ii. Dosalane.

$\frac{\text{Q.L.}}{\text{F.}} < \frac{1}{7}$

Order 5. Germanare.

$\frac{K_2O + Na_2O}{CaO} = \frac{95}{52} < \frac{7}{1} > \frac{5}{3}$

Rang 2.

$\frac{K_2O}{Na_2O} = \frac{35}{60} < \frac{3}{5} > \frac{1}{7}$

but very near $\frac{3}{5}$ limit.

∴ Subrang 4 Dosodic.

Magmatic name: Akerose, close to Monzonose.

W.1.
Trachy-Andesite.
Loc.: Timor Ledges.

	Per cent.
Zircon	0·18
Quartz	0·84
Orthoclase	37·81
Albite	38·25
Anorthite	7·23
Diopside	4·30
Hypersthene	4·20
Ilmenite	1·37
Magnetite	4·18
Calcite	0·10
Water	1·87
Sum	100·33

Salic Mins.	84·31
Femic Mins.	14·05

∴ $\frac{\text{Sal.}}{\text{Fem.}} < \frac{7}{1} > \frac{5}{3}$

Class ii.

$\frac{Q}{F} < \frac{1}{7}$ Order 5.

$\frac{K_2O + Na_2O}{CaO} = \frac{141}{26} < \frac{7}{1} > \frac{5}{3}$

Rang 2. Monzonase.

$\frac{K_2O}{Na_2O} = \frac{68}{73}$ Sodipotassic.

Magmatic name: Monzonose.

W.22.
Trachy-Andesite.
Loc.: Forked Mountain.

	Per cent.
Quartz	1·08
Orthoclase	36·70
Albite	38·25
Anorthite	10·29
Diopside	1·89
Hypersthene	3·61
Ilmenite	2·28
Magnetite	4·87
Water	1·30
Sum	100·26

Salic Minerals	86·32
Femic Minerals	12·65

Class ii.

$\frac{Q}{F} < \frac{1}{7}$ Order 5.

$\frac{K_2O + Na_2O}{CaO} = \frac{139}{37} < \frac{7}{1} > \frac{5}{3}$

Rang 2.

$\frac{K_2O}{Na_2O} = \frac{66}{73}$ Subrang 3.

Magmatic name: Monzonose.

W.222.
Phonolite.
Loc: Mt. Bingy Grumble.

	Per cent.
Orthoclase	37·25
Albite	46·11
Nephelite	6·25
Nosean	0·71
Zircon	0·55
Diopside	0·71
Wollastonite	1·97
Ilmenite	0·46
Magnetite	5·10
Water	1·66
Sum	100·77

$\frac{\text{Salic}}{\text{Femic}} = \frac{90·87}{8·24} > \frac{7}{1}$

Class i. Persalane.

$\frac{\text{Lenad}}{\text{Felspar}} = \frac{6·96}{83·36} < \frac{1}{7}$

Order 5. Canadare.

$\frac{K_2O + Na_2O}{CaO} = \frac{180}{0} > \frac{7}{1}$

Rang 1 (Peralkalic).

$\frac{K_2O}{Na_2O} = \frac{67}{113} < \frac{3}{5} > \frac{1}{7}$

but very near $\frac{3}{5}$ limit.

(Dosodic) Subrang 4.

Magmatic name: Nordmarkose, very near Phlegrose.

TABLE II.—CONTINUED.

W. 140.
Phonolite.
Loc.: near Mount Berum Buckle.

	Per cent.
Quartz	1·26
Orthoclase ...	37·25
Albite	48·73
Anorthite... ...	3·06
Nosean	0·71
Diopside	3·68
Magnetite .	3·94
Ilmenite	0·76
Zircon	0·37
Water	0·93
Sum	100·69

$\frac{\text{Salic}}{\text{Femic}} = \frac{91 \cdot 38}{8 \cdot 38}$
Class i. Persalane.

$\frac{\text{Q.} + \text{L.}}{\text{F.}} = \frac{1 \cdot 97}{89 \cdot 04} < \frac{1}{7}$
Order 5.

$\frac{K_2O + Na_2O}{CaO} = \frac{163}{11} > \frac{7}{1}$
Rang 1 (Peralkalic).

$\frac{K_2O}{Na_2O} = \frac{67}{96} < \frac{5}{3} > \frac{3}{5}$
(Sodipotassic) Subrang 3.

Magmatic name: Phlegrose

W. 16.
Arfvedsonite Trachyte.
Loc.: Timor Rock.

	Per cent.
Quartz	5·40
Orthoclase ...	34·47
Albite	53·45
Hypersthene ...	2·18
Acmite	0·46
Ilmenite	0·46
Magnetite ..	2·32
Fluorspar ...	0·16
Zircon	0·36
Excess F. ...	0·07
Water	0·70
Sum	100·03

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{93 \cdot 68}{5 \cdot 58} > \frac{7}{1}$
Class 1. (Persalane).

$\frac{\text{Q}}{\text{F}} = \frac{5 \cdot 4}{87 \cdot 92} < \frac{1}{7}$
Order 5 (Canadare).

$\frac{K_2O + Na_2O}{CaO} = \frac{165}{0} > \frac{7}{1}$
Rang 1 (Peralkalic).

$\frac{K_2O}{Na_2O} = \frac{62}{103} > \frac{3}{5} < \frac{5}{3}$
but very near $\frac{3}{5}$ limit.
Subrang 3 (Sodipotassic).

Magmatic name: Phlegrose, very near Nordmarkose.

W. 38.
Ægirine Trachyte.
Loc.: Timor Rock.

	Per cent.
Quartz	0·12
Orthoclase ..	32·80
Albite	60·26
Anorthite ...	0·28
Diopside... ...	1·42
Wollastonite . .	0·46
Ilmenite ...	0·46
Magnetite ...	3·94
Water	0·86
Sum	100·61

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{93 \cdot 46}{6 \cdot 29} > \frac{7}{1}$
Class i.

$\frac{\text{Q}}{\text{F}} = \frac{0 \cdot 12}{93 \cdot 34} < \frac{1}{7}$
Order 5.

$\frac{K_2O + Na_2O}{CaO} = \frac{174}{1} > \frac{7}{1}$
Rang 1.

$\frac{K_2O}{Na_2O} = \frac{59}{115} < \frac{3}{5} > \frac{1}{7}$
Subrang 4.

Magmatic name: Nordmarkose.

W. 127.
Porphyritic Soda Trachyte.
Loc.: N.E. of Berum Buckle.

	Per cent.
Quartz	7·86
Orthoclase ...	38·02
Albite	41·40
Corundum ...	3·37
Hæmatite ...	4·64
Titanite	0·39
Rutile	0·24
Ilmenite	0·30
Hypersthene ..	0·93
Water	2·05
Sum	99·20

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{90 \cdot 65}{6 \cdot 50} > \frac{7}{1}$
Class i.

$\frac{\text{Q}}{\text{F}} = \frac{7 \cdot 86}{79 \cdot 42} < \frac{1}{7}$
Order 5.

$\frac{Na_2O + K_2O}{CaO} = \frac{145}{0} > \frac{7}{1}$
Rang 1.

$\frac{K_2O}{Na_2O} = \frac{66}{75} < \frac{5}{3} > \frac{3}{5}$
Subrang 3.

Magmatic name: Phlegrose.

A
Trachyte.
Loc.: Mt. Flinders, near Ipswich, Queensland.

	Per cent.
Quartz	1·50
Orthoclase ...	40·59
Albite	42·44
Anorthite ...	6·39
Diopside... ...	1·68
Magnetite ...	2·09
Ilmenite	1·52
Hæmatite ...	1·60
Water	1·89
Sum	99·70

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{90 \cdot 92}{6 \cdot 89} > \frac{7}{1}$
Class i. Persalane.

$\frac{\text{Q}}{\text{F}} = \frac{1 \cdot 5}{89 \cdot 42} < \frac{1}{7}$
Order 5.

$\frac{K_2O + Na_2O}{CaO} = \frac{154}{23} < \frac{7}{1} > \frac{5}{3}$
Rang 2 (Domalkalic).

$\frac{K_2O}{Na_2O} = \frac{73}{81} < \frac{5}{3} > \frac{3}{5}$
Subrang 3 (Sodipotassic).

Magmatic name: Pulaskose.

TABLE II.—CONTINUED.

B
Trachyte.
Loc.: Parish Dungarry, near Dubbo, N. S. W.

	Per cent.
Quartz	16·74
Orthoclase	28·91
Albite	44·54
Diopside	2·94
Wollastonite	0·12
Magnetite	4·64
Ilmenite	0·46
Water	1·70
Sum	100·05

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{90 \cdot 19}{8 \cdot 16} > \frac{7}{1}$
Class i.

$\frac{Q}{F} = \frac{16 \cdot 74}{73 \cdot 45} < \frac{3}{5} > \frac{1}{7}$
Order 4. Brittanare.

$\frac{K_2O + Na_2O}{CaO} = \frac{137}{13} > \frac{7}{1}$
Rang 1. Liparase.

$\frac{K_2O}{Na_2O} = \frac{52}{85} > \frac{3}{5} < \frac{5}{3}$
near $\frac{3}{5}$ limit.
Subrang 3. Sodipotassic.

Magmatic name: Toscanose.

C
Trachyte.
Loc. The Canoblas, near Orange, N. S. W.

	Per cent.
Quartz	22·74
Orthoclase	21·68
Albite	49·25
Anorthite	0·56
Diopside	0·49
Hypersthene	1·95
Magnetite	2·78
Ilmenite	0·15
Water	0·70
Sum	100·30

$\frac{\text{Sal.}}{\text{Fem.}} = \frac{94 \cdot 23}{5 \cdot 37} > \frac{7}{1}$
Class i. Persalane.

$\frac{Q}{F} = \frac{22 \cdot 74}{71 \cdot 49} < \frac{3}{5} > \frac{1}{7}$
Order 4. Brittanare.

$\frac{K_2O + Na_2O}{CaO} = \frac{133}{4} > \frac{7}{1}$
Rang 1. Liparase.

$\frac{K_2O}{Na_2O} = \frac{39}{94} < \frac{3}{5} > \frac{1}{7}$
Subrang 4.

Magmatic name: Kallerudose.

D
Trachyte.
Loc.: Wantialable Creek, N. S. W.*

	Per cent
Quartz	34·3
Orthoclase	30·6
Albite	27·2
Anorthite	1·4
Corundum	0·9
Hypersthene	1·2
Magnetite	0·5

Class i. Persalane.
Order 4. Brittanare.
Rang 1. Liparase.
Subrang 3. Sodipotassic.
Magmatic name: Liparose.

* See Chem. Analyses of Igneous Rocks by H. S. Washington, Professional Paper No. 14, U.S. Geol. Surv.

E.
Jellore Trachyte.
Journ. Roy. Soc. N. S. Wales, Vol. xxxvii.

	Per cent.
Quartz	12·42
Orthoclase	23·91
Albite	51·35
Anorthite...	0·56
Diopside	6·23
Hypersthene	0·26
Magnetite	3·25
Ilmenite	0·46
Pyrite	0·10
Apatite	0·67
Water	1·21
Sum	100·42

Class i.
Order 4.
Rang 2.
Subrang 3.
Magmatic name: Toscanose.

Discussion of the Analyses.

The chemical analyses appearing in Table i., with the exception of those which are inserted for comparison (A to E), were carried out by myself in the research laboratory of the Chemical Department, Sydney University; and I desire to express my thanks to Professor Liversidge, M.A., F.R.S., etc., and Mr. Schofield, A.R.S.M., for putting at my disposal the apparatus necessary.

The exigencies of time did not permit me to make duplicate analyses. Though several of my analyses sum up below or above the limits of first-class work, none of them are so inferior as not to be useful for comparison.

The reader is recommended to compare the composition of the Warrumbungle Mountain rocks with the analyses of the trachytes from the Glass House Mountains, Q.,* from Mittagong, N.S.W.,† from the Mount Macedon district, Victoria,‡ and from the Otago Peninsula.§

Special Notes.

W.67. This rock was analysed to verify chemically the conclusion arrived at by microscopic examination, that this orthoclase basalt and the trachydolerites allied to it (*e.g.*, W.64) were formed by a mixture of magmas. The CaO and MgO are too low and the alkalies (especially K_2O) are too high to permit the rock to be referred to the basalts. Nor can it be referred to the trachydolerites, as the Al_2O_3 percentage is too low. The alkaline basalt from the Blow Hole Flow near Kiama|| is closer to it in chemical composition than any other rock of basaltic appearance of which I can find analytical records. The norm is that of "akerose." The rocks which usually have this composition,

* H. I. Jensen, These Proceedings, 1906, Part i.

† D. Mawson, Journ. Proc. Roy. Soc. N. S. Wales, Vol. xxxvii.

‡ Quoted by Prof. Gregory, Proc. Roy. Soc. Victoria, Vol. xiv., Pt.2.

§ P. Marshall, 'The Geology of Dunedin,' Q.J.G.S., Vol. lxii., 1906.

|| 'Geology of the Kiama-Jamberoo District,' Records Geol. Surv. N. S. Wales, Vol. viii., Pt.1.

namely, the akerites and many monzonites, are of an entirely different physical appearance and habit (compare "Akerite," N.15, Nandewar Mountains, H. I. Jensen in litteris). The minerals of the norm are in close agreement with those actually observed in the mode, a fact due to orthoclase and albite of a trachytic magma having mixed with augite, olivine, and basic felspar of a partially fused doleritic magma whereupon the whole mass has consolidated.

W.40. Corundum Basalt is a rock which contains minerals which by optical means alone could not be determined with accuracy. These were—(1) A black, lustreless, usually opaque mineral, which in very thin slices appeared occasionally to be translucent and bluish. It was wholly isotropic. The analysis shows that it cannot be spinel or magnetite, and that it must be corundum and sapphire. This determination bears out the Rev. J. M. Curran's theory that our sapphires are derived from basalt. (2) Yellow needles terminated by pyramids. This mineral was considered to be wöhlerite or laavenite. The high TiO_2 percentage and the presence of ZrO_2 make the occurrence of laavenite highly probable, and the titanic acid is so high that the allied minerals rosenbuschite and rinkite are probably also present.

The norm differs very considerably from the mode. The ground-mass is very readily gelatinised with dilute acid, indicating the presence of a felspathoid which probably contains most of the K_2O.

In the trachy-andesites, W.1 and W.22, we again notice that the mode is very different from the norm. This is, of course, because the hypersthene and diopside molecules are incorporated in the ægirine-augite. In W.22 the TiO_2 percentage is higher than in W.1, a fact which verifies the determination of pseudobrookite in the rocks of Nandi Mountain and The Forked Mountain. The norm of the trachyte-andesites calculates to monzonose. Rosenbusch (in 'Gesteinlehre') describes such rocks under the name keratophyre. This designation is, however,

better applied to hypabyssal rocks of similar composition (see Harker's Petrology).

	1. Trachy-andesite W.1. Warrumbungle Mts.		2. Keratophyre. Blankenburg, Harz.		3. Rhombenporphyr. Norway.	
SiO_2 ...	58·95		58·80		58·54	
$Al_2O_3+TiO_2$	17·80		17·43		17·28	
Fe Oxides ...	7·46		8·25		8·61	
MgO	0·57		1·83		1·81	
CaO	2·49		1·16		3·04	
Na_2O ...	4·51	10·90	5·22	9·49	7·18	10·42
K_2O	6·39		4·27		3·24	

The above table illustrates the close relationship between the keratophyre of Rosenbusch, Brögger's rhombenporphyr, and the Warrumbungle trachy-andesites.

A comparison of chemical compositions also shows that the monzonoses W.1 and W.22 lie between the arfvedsonite trachytes (W.16, W.38) and the sapphire basalt. If any rock in the district can be regarded as representing the parent magma, the trachy-andesite is the one.

The following table illustrates how the trachy-andesite may be regarded as occupying a position intermediate between the corundum basalt and the arfvedsonite trachyte.

	Corundum Basalt W.40.	Arfvedsonite Trachyte W.16.	Mean of W.40 & W.16.		Trachy-andesites W.1.	
SiO_2 ...	48·27	65·90	57·09		58·95	
Al_2O_3 ...	18·02	16·74	17·39		17·80	
Iron Oxides..	12·96	3·71	8·33		7·46	
MgO ...	1·17	0·06	0·61		0·57	
CaO	6·06	0·09	3·08		2·49	
Na_2O ...	3·73	6·35	5·04	9·58	4·51	10·90
K_2O ...	3·83	5·77	4·55		6·39	

The orthoclase basalt, W.67, also approximates in composition to a mixture of a dolerite, like the one from Dingo Creek in the Nandewar Mountains (N.17), with the monzonose W.1, thus—

	Dolerite N.17.	Monzonose W.1.	Mean.	Orth. Basalt W.67.
SiO_2 ...	47·20	58·95	53·07	51·88
Al_2O_3 ...	11·78	17·80	14·79	14·20
Fe Oxides ...	10·98	7·46	9·22	10·59
MgO ...	9·95	0·57	5·26	4·62
CaO ...	11·63	2·49	7·06	6·36
Na_2O ...	1·61	4·51	3·08 } 7·11	3·93 } 7·20
K_2O ...	1·67	6·39	4·03	3·27

The phonolites analysed, W.222 and W.140, are very high in alkali, as was expected from the amount of their felspathoid minerals, which form about 10 % of the mass. The determination of pseudoleucite appears from the chemical results to be correct, inasmuch as there is insufficient SO_3 to give so much nosean. In both of these rocks and also in the trachytes (W.16, W.38) the norm differs from the mode in that all the diopside and hypersthene molecules have gone to form ægirine augite and arfvedsonite. As these minerals are richer in silica than augite there has been insufficient silica left for the formation of felspar, hence felspathoids have formed. The trachytes and phonolites analysed fall in the divisions phlegrose and nordmarkose of the chemical classification, usually near the border line between the two subrangs.

The analysis of trachyte from Wantialable Creek (D, by J. C. H. Mingaye*) is interesting as being of very similar composition to the orthophyric pantellarite from Ngun-Ngun, Glass House Mountains, Queensland. The Mount Flinders trachyte contains barkevicite instead of arfvedsonite and is slightly more calcic than the Warrumbungle trachytes, and as a result falls in a different subrang. The Canoblas trachyte is much more like the orthophyric comendites of the Glass House Mountains than any of the Warrumbungle rocks.

* This rock has since been found to be a silicified trachyte tuff.

LIST OF ILLUSTRATIONS.

Fig.3.—Arfvedsonite Trachyte (W.215), Scabby Rock, showing microgranitic almost orthophyric structure. Nicols crossed.

Fig.4.—Trachytic Ægirine-Trachyte (W.109), Gibb's Gap, near Naman. Nicols crossed.

Fig.5.—Dark Ægirine-Trachyte (W. 9), Timor Ledges, with an ægirine crystal near the centre of the field. Nicols uncrossed.

Fig.6.—Dark Porphyritic Ægirine-Trachyte-Andesite or Keratophyre (W.22), Nandi Mountain, showing a dark mass of pseudobrookite and two microline microperthite phenocrysts. Nicols crossed.

Plate xxxi.

Fig.1.—Nosean Pseudoleucite Phonolite (W.222), Bingy Grumble. Nicols uncrossed; showing the femic minerals crowding round the felspathoids (nosean, etc.).

Fig.2.—Same as fig.7. Nicols crossed; showing black patches of isotropic nosean and pseudospherulitic aggregates of felspar microlites with interstitial analcite.

Fig.3.—Nosean-Arfvedsonite Leucitophyre, Berum Buckle. Nicols uncrossed. Notice the crystals of pseudoleucite.

Fig.4.—Same as fig.9. Nicols crossed. Note the trachytic and flow-structure of the base.

Fig.5.—Orthoclase-Basalt (W.67), The Spire, showing coarse-grained gabbroic inclusion adjoining fine-grained base of trachydolerite composition.

Fig.6.—Xenocryst of Labradorite studded with magnetite inclusions in W.67.

Plate xxxii.

Fig.1.—Xenocryst of Labradorite with inclusions in trachydolerite (W.85).

Fig.2.—Meliphanite Basalt (W.58), Mt. Gowang. Nicols uncrossed.

Fig.3.—Same, Nicols crossed; showing a portion of the base crystalline in outline, and composed of similarly oriented felspar microlites.

The following three figures belong to the Paper on the Geology of the Nandewar Mts., to appear later.

N.1.—Perlitic Pitchstone (N.62), Boggabri. Nicols uncrossed.

N.2.—Dolerite (N.17), Dingo Creek; the extinguished crystal is augite, the small bright crystal near it is olivine. Nicols crossed.

N.3.—Sölsverbergite (N.8), Bullawa Creek, showing microperthitic felspar phenocrysts. Nicols uncrossed.

[Printed off October 23rd, 1907.]

WEDNESDAY, SEPTEMBER 25TH, 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, September 25th, 1907.

Mr. J. H. Maiden, F.L.S., &c., Vice-President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 15 Vols., 67 Parts or Nos., 28 Bulletins, 2 Reports, and 1 Pamphlet, received from 50 Societies, &c., and 2 Individuals, were laid upon the table.

DISCUSSION: NOTES AND EXHIBITS.

The Chairman invited discussion upon the points raised in Dr. J. B. Cleland's "Note on the resistance of the Vegetation of Australia to Bush-Fires, and the Antiquity of the Australian Aboriginal," communicated at the last Meeting. Messrs. Fletcher, A. G. Hamilton, W. M. Carne, Baker, A. A. Hamilton, Cheel, J. F. Campbell, Dr. Woolnough, Professor David, and the Chairman took part in the discussion; the Secretary also communicated an interesting note from Mr. T. Stephens, of Hobart, bearing on the subject. Evidence was adduced showing that many Australian plants offered evident and characteristic examples of adaption to arid conditions or the concomitant circumstances, with which the Aboriginal was not in any way concerned. Wattles in some cases will germinate freely without any assistance from fires. The case of *Lyperanthus nigricans* was comparable with that of certain Cape bulbs (*Cyrtanthus*), both being examples of plants which are propagated largely by vegetative means, and in which the vegetative energy needs a

check before sexual reproduction ordinarily manifests itself.* Stringy-barks are apt to be killed by fire when the sap is down. On the whole as regards any possible share of the fire-kindling Aboriginal in the direct modification of the vegetation, upon the evidence available, "not proven" seemed to be the only warrantable verdict.

Professor David referred to the occurrence of stone tomahawks, and of a charred stump of Banksia, at Shea's Creek, near Sydney, six feet below present low-water mark;† and of charred roots at Narrabeen, at a depth of 50 feet—an indication of fires when the coast-line stood fifty feet higher than at present; and he pointed out that, in the latter case, if it could be shown that the fires were the result of human agency, very considerable antiquity for the Australian Aboriginal might be claimed (from 5,000-10,000 years, allowing 1 foot or 6 inches as a moderate estimate of the average rate of subsidence per century).

But though the Aboriginal may have had no share in directly modifying the flora, in some cases, he certainly did locally control geographical distribution to some extent, as pointed out by Mr. Stephens. In 1825, the Van Diemen's Land Company obtained a charter authorising the issue of a Crown grant of land in the unexplored country of north-west Tasmania In 1827, the district was explored by Mr. Hellyer, whose careful description of the country is on record. Finally 160,000 acres were selected and surveyed, extensive improvements were made, and the country was stocked with sheep; but having an average elevation of 2000-3000 feet, it was found to be suitable only for a summer run. After struggling for some time against heavy losses, the Company's managers eventually gave up the occupation of the greater part of the country; and later on it was rented, for some years, by outsiders, as a cattle-run. Prior to occupation, the

* See Darwin's "Plants and Animals under Domestication," Vol. ii., chap. xviii.; Maxwell T. Masters' "Vegetable Teratology," p.177; Henslow's "Floral Structures," p.231.

† Journ. Proc. Roy. Soc. N. S. Wales, xxx., pp.174-175.

Aborigines were in the habit of periodically burning off portions of the open country to improve the grass lands, the favourite feeding grounds of the kangaroos and wallabies. Soon after Hellyer's exploration the Aborigines were driven away from their favourite haunts, and finally exterminated; and the forest, unchecked by periodical fires, shortly began to resume possession of the pastoral country; so that thousands of acres of "the large tracts of open country as far as the eye could reach," and "the grassy hills of great extent," described in Hellyer's report, were subsequently covered with scrub and timber.

Mr. North sent for exhibition a set of four eggs of the Plumed Egret, *Mesophoyx plumifera* (Gould), with the following note:—"The eggs of *Mesophoyx plumifera* here exhibited were taken by Mr. Septimus Robinson on Buckiinguy Station, N.S.W., on the 8th November, 1893. Mr. Robinson reported that he found about a dozen or more nests of this species; they were nearly flat, and scantily formed structures of thin sticks and twigs; and were so small that they were almost concealed by the birds when sitting. They were built in gum, or 'Humulung' (*Acacia* sp.?) saplings, standing in water where the Macquarie River had overflowed its banks, and varied in height from seven to twenty feet from the surface of the water, most of them not being higher than twelve feet, and in some saplings were two nests. Each nest contained four eggs, some being fresh, others well advanced in incubation. The eggs are almost true ellipses in form, the shell being close-grained, with fine pittings, otherwise smooth and lustreless. They are of a uniform pale sea-green colour, with here and there scattered over the shell almost invisible white limy-incrustations, and measure as follows:—length (A) 1·82 × 1·32; (B) 1·81 × 1·2; (C) 1·82 × 1·23; (D) 1·83 × 1·29 inches. Last July, through the kindness of Mr. Charles French, Junr., I was enabled to examine a set of three eggs of the Plumed Egret taken by Mr. J. Ross near Mathoura, N.S.W., in November, 1906. They were similar in shape and colour, but slightly larger than the specimens now exhibited. Although

Mr. Robinson took the eggs of the Plumed Egret so many years ago, hitherto, I believe the eggs of this species have remained undescribed."

Mr. Musson sent for exhibition, specimens illustrating two forms of the common "Blackthorn" (*Bursaria spinosa* Cav.; N.O. PITTOSPOREÆ), namely, the common type, more or less thorny or spiny, with small leaves, from poor rocky ground; and a form of more robust growth, without spines, and with large leaves, from rich soil on the Darling Downs, Queensland.

Mr. R. T. Baker showed specimens of two remarkable plants from New Zealand, commonly known as "Vegetable Sheep," *Raoulia eximia* Hook. f., and *R. mammillaris* Hook. f. [N.O. COMPOSITÆ]. They are to be found in the New Zealand Alps, at altitudes varying from 3,000-6,000 feet, where they form hemispherical woolly cushions varying in diameter and height from a few inches to eight feet, and three feet respectively. The largest specimen exhibited measured 2 feet 6 inches diam., and 14 inches high.

Mr. A. G. Hamilton exhibited a number of individual flowers from a Waratah head (*Telopea speciosissima* Smith) showing an interesting series of gradational abnormalities. The lowest rows comprised normal flowers. The flowers immediately above these were characterised by the presence of a slight groove in the pedicel, corolla and style of each of them. In the flowers of the uppermost rows the groove had deepened, until finally each pedicel and flower had become completely divided, the only junction being at the base of the pedicels.

REVISION OF AUSTRALIAN LEPIDOPTERA, IV.

By A. J. Turner, M.D., F.E.S.

(Continued from Proceedings, 1906, xxxi., p.710.)

Fam. GEOMETRIDÆ.

Subfam. Hydriomeninæ.

During the few months since the publication of my last
stalment (These Proceedings, 1906, p.682) five new species have
me into my hands, increasing the total to 168. On a moderate
mputation there should be 200 species of this family in
ustralia, and I hope to live to see this number exceeded.

Chloroclystis laticostata.

Q.: Adavale.

Chloroclystis elaeopa,* n.sp.

♀. 19-21 mm. Head and palpi ochreous-whitish, greenish-
nged. Antennæ grey, basal joint ochreous-whitish. Thorax
d abdomen ochreous-green irrorated with dark fuscous. Legs
hreous-whitish, greenish-tinged; anterior tibiæ and tarsi fuscous;
sterior tibiæ with inner distal spur long, outer distal spur ⅔
ner, inner proximal spur long, outer proximal spur obsolete.
rewings triangular, costa arched only at extremities, middle
rtion straight or slightly excavated, apex rounded, termen
wed, oblique; dull greenish, with dark fuscous transverse lines
d irroration; several incomplete basal lines; a quadrate spot
costa at ⅓, giving rise to two indistinct lines; a second similar
stal spot beyond middle, from its posterior edge a fine crenated

* ἐλαιωπος, olive-green.

postmedian line to $\frac{3}{4}$ dorsum; suffused subterminal and submarginal lines; an interrupted darker terminal line; cilia dull greenish. Hindwings with termen rounded; colour and markings as forewings, but without costal spots. Underside greenish-ochreous with well marked dark fuscous antemedian, postmedian, subterminal, and terminal lines; forewings with space between base and antemedian line suffused with fuscous.

Type in Coll. Turner.

N.Q.: Kuranda; in October and December; two specimens (Mr. F. P. Dodd).

CHLOROCLYSTIS ATHAUMASTA,* n.sp.

♀. 19-20 mm. Head and antennæ fuscous-whitish. Palpi dark fuscous. Thorax and abdomen ochreous-whitish, greenish-tinged, the latter irrorated with dark fuscous, especially on terminal half, but not on apical segment. Legs fuscous; posterior pair fuscous-whitish, outer spurs distal $\frac{1}{2}$, proximal $\frac{1}{4}$. Forewings triangular, costa slightly arched, apex rounded, termen bowed, oblique; fuscous-whitish, greenish-tinged, with some dark fuscous irroration; lines very indistinct, fuscous; postmedian from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, curved outwards, somewhat dentate; sometimes a dentate whitish subterminal line edged anteriorly with fuscous; a fuscous terminal line interrupted on veins; cilia fuscous. Hindwings with termen rounded; colour and markings as forewings. Underside pale fuscous with a darker postmedian line.

Type in Coll. Turner.

N.Q.: Kuranda; in September and October; five specimens (Mr. F. P. Dodd).

CHLOROCLYSTIS PERISSA,† n.sp.

♀. 20-21 mm. Head bright green. Palpi moderate (2); whitish mixed with green, at apex dark fuscous. Antennæ grey, basal joint whitish. Thorax dark fuscous mixed with green. Abdomen

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* ἀθαυμαστος, not admired.

† περισσος, above the common.

with crests represented by scanty erect hairs; dark fuscous with green blotches. Legs whitish; anterior pair fuscous, anterior coxæ green; posterior pair with outer spurs $\frac{2}{3}$. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; bright green with transverse fuscous lines variably developed; an interrupted line close to base; three lines forming a subbasal band, followed by a single slender line, and this again by a broad antemedian line at $\frac{1}{3}$, expanded on costa; median area sometimes pure green, sometimes suffused with fuscous; postmedian line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, bowed outwards in disc; followed shortly by a subterminal band of three closely approximated lines; cilia whitish, obscurely fuscous on veins. Hindwings small, termen rounded; whitish; towards dorsum and termen suffused with fuscous and green; cilia whitish. Underside whitish; forewings suffused with grey towards costa and termen.

Not near any other Australian species. The sharp contrast between fore and hindwings is a striking character. Possibly the male might show structural differences.

Type in Coll. Turner.

N.Q.: Kuranda; in September; three specimens (Mr. F. P. Dodd).

Hydriomena subrectaria.

Q.: Nanango.

Hydriomena subochraria.

Q.: Dulong near Nambour.

Hydriomena epicteta,* n.sp.

♂♀. 22-30 mm. Head, palpi, antennæ, thorax, and abdomen grey-whitish. Palpi $2\frac{1}{4}$. Antennæ in ♂ very shortly laminate, ciliations $\frac{1}{4}$. Legs whitish irrorated with fuscous; anterior pair mostly fuscous. Forewings triangular, costa rather strongly arched, apex tolerably acute, termen slightly sinuate beneath apex, bowed, slightly oblique; pale grey, in ♀ darker; a small

* ἐπικτητος, acquired in addition, newly acquired.

fuscous basal blotch, limited by a faint whitish line from $\frac{1}{8}$ costa to $\frac{1}{4}$ dorsum; a fuscous median band containing a minute darker discal dot, limited by fine whitish lines, the anterior outwardly curved or with an angular posterior projection below middle, the posterior with a very strong acute median process; immediately beneath this process the median band is usually constricted or interrupted, in the ♂ the interruption may be wide, and the lower division of the band may be much reduced in size, or even absent; a fine whitish subterminal line, and a pale oblique subapical streak, both better marked in ♀; a very fine grey terminal line; cilia grey, apices partly white. Hindwings with termen rounded, wavy; pale grey; a fine fuscous terminal line; cilia grey, apices whitish.

Very similar to *H. interruptata*, and varies in an analogous way, but a series of each species shows unmistakable differences. It lacks the brownish coloration and the strong white lines of *interruptata*, its basal line is less oblique, and is not angled near dorsum, and there are other minor points of difference.

Type in Coll Lyell.

Vic.: Gisborne, and Lorne; in January, February, and March; ten specimens.

DIPLOCTENA PANTOEA,* n.sp.

♂♀. 20-22 mm. Head dark fuscous irrorated with pale reddish Palpi $2\frac{1}{2}$; dark fuscous mixed with ochreous-whitish. Antennæ dark fuscous annulated with whitish; in ♂ with two pairs of fine long (6) pectinations on each joint, pectinations nearly equidistant. Thorax and abdomen dark fuscous irrorated with whitish and pale reddish; a small posterior thoracic crest, and a minute dorsal crest on second abdominal segment. Legs dark fuscous, irrorated, and tarsi annulated, with whitish. Forewings in ♂ triangular, costa moderately arched, apex rounded, termen bowed, slightly oblique; dark fuscous-brown; median band ill-defined, containing a large dark fuscous reniform spot; outer edge of median band marked by minute white dots, which are

* παντοιος, of all kinds.

not always present; another series of minute white dots marks the subterminal line; a dark fuscous terminal line; cilia dark fuscous, apices brownish. Forewings in ♀ with apex more acute, ground-colour pale brown, median band containing a dark fuscous median band. Hindwings in both sexes with termen rounded; whitish with a slight purplish tinge and some grey irroration tending to form transverse lines.

Ab. *a.* ♂. Reniform spot white or whitish outlined with dark fuscous.

Ab. *b.* ♂. Whole of disc except base, upper part of median band, and a terminal band, brown-whitish.

A variable but unmistakable species.

Type in Coll. Lyell.

Vic.: Lorne; in February and March; nine specimens.

Xanthorhoe brujata.

Q.: Dulong, near Nambour.

Subfam. Sterrhinæ.

Forewings with 7, 8, 9, 10 stalked, 11 anastomosing with their common stalk to form a single or double areole (in the latter case 10 may arise either separately or from the common stalk), or more rarely there is no areole, 11 arising from the common stalk. Hindwings with 5 from middle or slightly above middle of cell, not strongly approximated to 6 (except in *Dasybela*), 8 anastomosing very shortly with cell near base, then rapidly diverging. Posterior tibiæ of ♂ frequently without spurs, and more or less abbreviated or distorted.

In the European genus *Cleta* vein 11 of forewings is free.

In his Australian revision Mr. Meyrick included the *Sterrhinæ* with the *Geometrinæ*, but subsequently in his European revision* recognised the two groups as distinct. The former is certainly an offshoot of the latter and very closely connected with it. They are indeed not separable by any absolute definition, for the

* Trans. Ent. Soc. 1892.

approximation of vein 5 of the hindwings to 6 is present to a slight degree in several genera, and in the genus *Dasybela* is as strongly marked as in the *Geometrinæ*. Nevertheless they form a natural group and may conveniently be kept separate. In the neuration there are but few variations, and some of these, such as the separation or stalking of veins 6 and 7 of the hindwings, are not of generic value, being sometimes variable in closely allied species or even the same species. The structure of the posterior tibiæ of both sexes and of the ♂ antennæ gives trustworthy generic characters, and I am satisfied that without making use of these it is impossible to classify this subfamily in a natural manner.

I have 74 species of this group in my collection, and have examined all the species in the collection of Mr. Geo. Lyell, together with all the types in the British Museum, and the great majority of those described by Mr. Warren, Dr. Lucas, and Mr. Lower. Sir Geo. Hampson has helped me in the naming of species of the *Anisodes* group received by me since my visit to England.

While the *Sterrhinæ* are represented in temperate regions, they are more abundant in the tropics. In Mr. Meyrick's revision, published in 1887, 32 species were ascribed to 5 genera. The present revision contains 102 species ascribed to 20 genera. Some of these are, however, only imperfectly known, and the number of unrecognised species is still considerable. When the tropical parts of Australia are adequately explored many new species will be discovered.

I have followed Mr. Meyrick in dividing the genus formerly known as *Acidalia* Treitschke, into several genera of which *Eois* Hb., and *Leptomeris* Hb., are the most important.

Tabulation of Genera.

1. Palpi short or moderate, seldom exceeding rons, terminal joint not elongate.......................... 2.
   Palpi long, second joint well exceeding frons, terminal joint elongate (at least in ♀)........... 13.

2. Forewings with a simple areole (or rarely a double areole but 10 stalked with 7, 8, 9)	3.
Forewings with a double areole, 10 arising separately	10.
Forewings without areole, 7, 8, 9, 10, 11 stalked...	12. CHRYSOCRASPEDA.
3. Antennæ of ♂ simple or serrate, ciliated	4.
Antennæ of ♂ laminate, or shortly pectinate, with long terminal fascicles of cilia	11.
Antennæ of ♂ pectinate, without terminal fascicles of cilia	12.
4. Posterior tibiæ of ♀ without middle spurs	5.
Posterior tibiæ of ♀ with two pairs of spurs	8.
5. Posterior tibiæ of ♂ without spurs	6.
Posterior tibiæ of ♂ with terminal spurs	7. STERRHA.
6. Hindwings of ♂ with a glandular swelling and deeply incised at tornus	1. MNESTERODES.
Hindwings of ♂ not so	7.
7. Middle tibiæ and basal tarsal joints of ♂ clothed with long hair	2. XENOCENTRIS.
Middle tibiæ and tarsi of ♂ normal	3. EOIS.
8. Posterior tibiæ of ♂ without spurs	4. LEPTOMERIS.
Posterior tibiæ of ♂ with terminal spurs	9.
9. Palpi and underside of thorax clothed with long rough hairs	5. DASYBELA.
Palpi and thorax not hairy	6. PYLARGE.
10. Posterior tibiæ of ♂ without spurs	8. SOMATINA.
Posterior tibiæ of ♂ with terminal spurs	9. AUTANEPSIA.
11. Abdomen without lateral tufts	10. PROBLEPSIS.
Abdomen with lateral tufts of long hairs on apical segments	11. TRYGODES.
12. Forewings with 11 anastomosing very shortly, well before origin of 7	13. PTOCHOPHYLE.
Forewings with 11 anastomosing for some distance beyond origin of 7	14. GNAMPTOLOMA.
13. Forewings with areole double	15. ORGANOPODA.
Forewings with areole single	14.
14. Posterior tibiæ of ♂ extremely short and densely tufted with long hairs, first joint of tarsi immensely elongate	16. BRACHYCOLA.
Posterior tibiæ and tarsi of ♂ not so	15.
15. Posterior tibiæ of ♂ without middle spurs	16.
Posterior tibiæ of ♂ with one or two middle spurs	17.

16. Posterior femora of ♂ with a dense hair-tuft....... 17. PERIXERA.
    Posterior femora of ♂ smooth......................... 18. ANISODES.
17. Posterior tibiæ of ♂ with a single middle spur..... 19. PISORACA.
    Posterior tibiæ of ♂ with all spurs present.......... 20. DIZUGA.

Gen. 1. MNESTERODES.*

Mnesterodes Meyr., Trans. Ent. Soc. 1889, p.483.

Face smooth. Palpi short, slender, porrect, or slightly ascending. Antennæ in ♂ serrate, ciliated. Posterior legs in ♂ rudimentary, tibiæ moderately thickened towards apex, tarsi subaborted, posterior tibiæ in ♀ without middle spurs. Forewings in ♂ without scales on dorsal part of disc beneath; 3 and 4 separate, 7, 8, 9, 10 stalked, 11 anastomosing with their common stalk. Hindwings with termen incised at tornus in both sexes, but more deeply in ♂; in ♂ with a pencil of long hairs from base of costa above, a central oval glandular swelling, and no scales on central portion of disc on uppersurface; 3 and 4 widely separate at base, 5 from middle of cell, 6 and 7 stalked.

A development of *Eois*. The hindlegs of ♂ are intermediate between the two sections of that genus. The characters given are those of the type; further discoveries may lead to their extension.

1. MNESTERODES TRYPHEROPA.†

♂. *Mnesterodes trypheropa* Meyr., Trans. Ent. Soc. 1889, p.483.
♀. *Ptychopoda angustipennis* Warr., Nov. Zool. 1897, p.223.

♂. 12-13 mm. Head whitish-ochreous; face and palpi fuscous. Antennæ whitish-ochreous; in ♂ serrate with short ciliations (⅔). Thorax and abdomen whitish-ochreous. Legs whitish-ochreous; anterior pair fuscous; posterior tarsi of ♂ ½ length of tibia. Forewings triangular, costa gently arched, apex round-pointed, termen long, bowed, oblique, dorsum short; whitish-ochreous; a small discal dot, and a broad ill-defined subterminal fascia fuscous; cilia whitish-ochreous. Hindwings with

* μνεστηρώδης, like a wooer.

† τρυφερωπος, of delicate appearance.

rmen first rounded, then deeply incised at tornus; a dense ncil of long ochreous hairs from base of costa; disc scaleless, th silvery lustre; a large oval central glandular swelling best en beneath, concealed by tuft on upper surface; a pale fuscous rminal band; cilia pale fuscous.

♀. 12 mm. Forewings more elongate, dorsum longer relatively termen; a pale fuscous antemedian line at ¼ outwardly curved; fine, straight, slightly wavy median line; subterminal fascia ry distinct. Hindwings slightly incised at tornus; a fine antedian line; a broad fascia near but not touching termen; cilia itish.

Type in Coll. Meyrick.

N.Q.: Cooktown, Kuranda, Townsville; in December, March, ril, and June; six specimens (Mr. F. P. Dodd).

Gen. 2. XENOCENTRIS.

nocentris Meyr., Trans. Ent. Soc. 1889, p. 484.

Face smooth. Palpi short, slender, porrect, or slightly ascend-. Antennæ in ♂ simple or slightly serrate, with moderate ations or with long cilia in fascicles. Middle legs of ♂ with iæ normal or shortened, spurs well-developed, inner spur ger, sometimes abnormally large, tibiæ and basal tarsal joints thed with long hair; posterior tibiæ in ♂ without spurs, tarsi torted, tapering to a point or ending in a large obtuse club; terior tibiæ in ♀ without middle spurs. Forewings with 3 l 4 separate, 7, 8, 9, 10 stalked, 11 anastomosing with their nmon stalk. Hindwings with 3 and 4 separate, 5 from middle cell, 6 and 7 stalked; in ♂ dorsal area sometimes densely thed with hairy scales.

Type *X. rhipidura* Meyr., from New Guinea.

Also a development from *Eois*, originating from Sect. i. of that nus. There is considerable specific variation both in the tennal ciliations of the ♂ and in the middle tibiæ and tarsi of ♂, which latter distinguish the genus from *Eois*. *Xenocentris* probably a genus of considerable extent in the Papuan subgion. *X. epipasta* is the least modified species.

1. Posterior tarsi in ♂ ending in an obtuse club...............	2.
Posterior tarsi in ♂ tapering to a point....................	3.
2. Hindwings oblong, with strongly bowed termen, wings reddish..	2. *dasypus.*
Hindwings not oblong, termen rounded, wings whitish.	3. *rhopalopus.*
3. Wings reddish.	4.
Wings whitish..	5.
4. Fore tibiæ of ♂ densely hairy.	4. *crinipes.*
Fore tibiæ of ♂ smooth..	5. *catacoma.*
5. Forewings with a broad median dark grey fascia.........	6. *fasciata.*
Forewings without median fascia	6.
6. Middle tibiæ and first four tarsal joints in ♂ clothed with very long dense hairs..	7. *pilosata.*
Middle tibiæ and first joint of tarsi in ♂ moderately hairy.	8. *epipasta.*

Section i. *Posterior tarsi of ♂ forming a large obtuse club.*

2. Xenocentris dasypus,* n.sp.

♂. 18 mm. Head whitish; face fuscous. Palpi ochreous. Antennæ whitish; in ♂ shortly and evenly ciliated ($\frac{2}{3}$). Thorax and abdomen pale pinkish-grey. Legs ochreous; middle tibiæ in ♂ moderately long, clothed with dense long hairs externally, outer spur well developed, inner spur twice as long as outer, basal tarsal joint elongate and clothed with long hairs externally; posterior tibiæ and tarsi in ♂ short and much dilated, forming an obtuse club. Forewings rather elongate-triangular, costa moderately arched, apex rounded, termen nearly straight, oblique; pale pinkish; markings pale fuscous, very indistinct; indications of fine antemedian, median, and postmedian lines; cilia pinkish-white. Hindwings diamond-shaped, strongly bowed and very prominent on vein 5; colour and markings as forewings.

The peculiarly shaped hindwings should make this species easy of recognition.

N.Q.: Kuranda; in April; one specimen (Mr. F. P. Dodd).

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* δασυπους, hairy-footed.

3. XENOCENTRIS RHOPALOPUS,* n.sp.

♂. 15-16 mm. Head, thorax, and abdomen ochreous-whitish. Face fuscous; palpi fuscous-whitish. Antennæ ochreous-whitish; in ♂ with moderate ciliations (1). Legs whitish-ochreous; middle tibiæ and first tarsal joints in ♂ clothed with long hairs (damaged in my examples); posterior tibiæ and tarsi forming a large obtuse club, broadest near extremity, with a large tuft of expansile hairs on its inner aspect. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; ochreous-whitish with fuscous irroration and markings; antemedian line from $\frac{1}{3}$ costa bent inwards at a right angle in disc, and again at a right angle to end in $\frac{1}{4}$ dorsum; a median line from midcosta to $\frac{2}{3}$ dorsum; postmedian, subterminal, and submarginal lines faintly indicated; an interrupted fuscous terminal line; cilia ochreous-whitish with fuscous irroration. Hindwings with termen rounded; colour and markings as forewings.

Type in Coll. Turner.

N.Q.: Townsville; in November; two specimens (Mr. F. P. Dodd).

Section ii. *Posterior tarsi of ♂ tapering to a point.*

4. XENOCENTRIS CRINIPES.

Ptychopoda crinipes Warr., Nov. Zool. 1897, p.224.

Type in Coll. Rothschild.

N.Q.: Cooktown. I have no examples of this species.

5. XENOCENTRIS CATACOMA,† n sp.

♂♀. 17-18 mm. Head, thorax, and abdomen whitish tinged with pinkish. Face dark fuscous. Palpi fuscous. Antennæ whitish; in ♂ with tufts of long cilia (4). Legs ochreous-whitish; anterior pair slightly infuscated; middle tibiæ in ♂ very short, fringed with long hairs internally, outer spur slender, longer than

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* ῥοπαλοπους, club-footed.

† καταcομος, with luxuriant hair.

tibia, inner spur twice as long and immensely dilated, first and second tarsal joints much elongate and fringed with long hairs internally, second tarsal joint with long hairs internally; posterior tibiæ in ♂ short and flattened, tarsus ploughshare-shaped, joints not discernible. Forewings triangular, costa straight except near base and apex, apex rounded, termen bowed, oblique; pale pinkish; markings fuscous; traces of an antemedian line; an obscure discal dot, closely followed by a very fine denticulate line from $\frac{2}{3}$ costa to middorsum; subterminal represented by a series of dark fuscous dots on veins; an interrupted grey terminal line; cilia pale pinkish. Hindwings with termen rounded; colour and markings as forewings.

The structure of the legs and antennæ appears to closely resemble that of *X. rhipidura* Meyr., but it has not the enlarged genital tufts of that species.

Type in Coll. Turner.

N.Q.: Kuranda, in May and July; three specimens (Mr. F. P. Dodd).

6. Xenocentris fasciata.

Xenocentris fasciata Warr., Nov. Zool. 1898, p.245.

Type in Coll. Rothschild.

Q.: Rockhampton. I have no example of this species.

7. Xenocentris pilosata.

Ptychopoda pilosata Warr., Nov. Zool. 1898, p.21.
Eois œnopus Low., Trans. Roy. Soc. S. Aust. 1902, p.249.

♂♀. 14-16 mm. Head, thorax, and abdomen ochreous-whitish. Face and palpi fuscous. Antennæ ochreous-whitish; in ♂ with moderate ciliations (1). Legs whitish-ochreous; anterior pair slightly infuscated; in ♂ with middle tibiæ clothed with very long dense hairs above, outer spur moderate, inner spur very long (2), first tarsal joint elongate, and together with second, third, and fourth joints clothed with dense hairs above, those on first joint very long, shortening to fourth joint; posterior legs in ♂ rudimentary, tarsi moderately long ($\frac{2}{3}$), rather short at base,

ering to apex, with a large expansile tuft of purplish hairs ernally. Forewings triangular, costa gently arched, more ngly so towards apex, apex rounded, termen bowed, oblique; reous-whitish; a fuscous suffusion on basal half of costa; a antemedian line at ¼, sometimes obsolete; a median discal a fine, slightly wavy postmedian line at ⅝, sometimes obso- subterminal and submarginal lines faintly indicated; cilia ish-ochreous, sometimes with indications of fuscous basal . Hindwings with termen rounded; in ♂ dorsal area beneath ely clothed with long scales.

ype in Coll. Rothschild.

b.*a*. With conspicuous fuscous subterminal and submarginal on both wings. One male from Kuranda, agreeing struc- lly with the typical form.

Q.: Cooktown, Cairns, Kuranda, Townsville; in June, Sep- ber, February, and March.

8. Xenocentris epipasta,* n.sp.

♀. 16-19 mm. Head ochreous-whitish; face and palpi fuscous. nnæ ochreous-whitish; in ♂ slightly serrate, with moderate tions (1). Thorax and abdomen ochreous-whitish with a few ered dark fuscous scales. Legs whitish-ochreous; anterior somewhat infuscated; in ♂ with middle tibiæ normally loped, clothed with rather long hairs above, spurs rather , inner spur 1½, first tarsal joint elongate and clothed with er long hairs above; posterior legs in ♂ rudimentary, tarsi er long (⅔), moderately slender, acute, clothed with long . Forewings triangular, costa gently arched, more strongly wards apex, apex rounded, termen bowed, oblique; ochreous- ish with dark fuscous markings and sparsely scattered scales; median line obsolete, represented by a dot on costa at ¼; a an discal dot; postmedian line from ⅝ costa to ¾ dorsum, times well-marked, sometimes obsolete except at extremities; erminal and submarginal lines sometimes faintly indicated;

* ἐπιπαστος, besprinkled, irrorated.

cilia ochreous-whitish with a basal series of dark fuscous dots opposite veins. Hindwings with termen rounded; in ♂ dorsal area beneath densely clothed with hairy scales; colour and markings as forewings.

Type in Coll. Turner.

N.Q.: Kuranda; in July, August, and October.—Q.: Nambour, Brisbane; in December and February.

Gen. 3. Eois.

Eois Hb., Verz. p.308; Meyr., Trans. Ent. Soc. 1892, p.86.
Ptychopoda Steph., Ill. Brit. Ent. iii. p.305.

Face smooth. Palpi short, slender, porrect, or slightly ascending. Antennæ in ♂ ciliated. Posterior tibiæ and tarsi in ♂ slender and rudimentary, or more or less dilated and distorted; posterior tibiæ in ♀ without middle spurs. Forewings with 7, 8, 9, 10 stalked, 11 anastomosing with their common stalk, forming a single areole. Hindwings with vein 5 from middle of cell, 6 and 7 stalked.

A large and cosmopolitan genus. In the Australian species 6 and 7 of hindwings are always stalked; according to Meyrick they are rarely separate in exotic species. The Australian species may be readily separated into two sections according to the structure of the hindlegs of the ♂, but it must not be supposed that these would form tenable genera. In the following table, which is based on characters only found in the ♂—and I am convinced that this is the only scientific method of studying this genus—the following species are unavoidably omitted: *E. alopecodes* Meyr., *iodesma* Meyr., *plumboscriptaria* Christ., *polygramma* Low., *stenozona* Low.

1.	♂ with posterior tibiæ more or less dilated and distorted	2.
	♂ with posterior tibiæ slender, abbreviated................	7.
2.	♂ with tarsi dilated and distorted..........................	3.
	♂ with tarsi slender..	5.
3.	Forewings with pale ochreous transverse lines............	10. *coercita*.
	Forewings without ochreous lines...........................	4.
4.	Wings reddish-grey...	9. *costaria*.
	Wings whitish..	12. *eretmopus*.

Wings dark greenish	11. *liparota*.
Wings whitish	6.
Cilia with basal dark fuscous dots	13. *elaphrodes*.
Cilia without dark fuscous dots	14. *dolichopis*.
Wings with fuscous and orange (or ferruginous) lines	8.
Wings without orange (or ferruginous) markings	9.
Forewings with postmedian line showing an acute projection above middle	15. *ferrilinea*.
Postmedian line of forewings without acute projection	16. *cletima*.
Wings pinkish- or reddish-tinged	10.
Wings whitish without reddish tinge	12.
Forewings with a whitish costal streak	17. *albicostata*.
Forewings without whitish costal streak	11.
Wings with fuscous lines or dots	18. *halmaeata*.
Wings without fuscous markings	19. *scintillans*.
Wings with transverse lines pale ochreous	20. *fucosa*.
Wings with transverse lines fuscous or grey	13.
Forewings with a whitish costal streak	14.
Forewings without costal streak	15.
Forewings with costal edge reddish	21. *probleta*.
Forewings with costal edge not reddish	22. *nephelota*.
Forewings with median line obsolete	23. *pseliota*.
Forewings with median line distinct	16.
Forewings with distinct discal dot	24. *pachydetis*.
Forewings without discal dot	25. *philocosma*.

ion i. *Hind tibiæ of ♂ more or less dilated and distorted* (Ptychopoda).

9. Eois costaria.

lalia costaria Wlk., Brit. Mus. Cat. xxvi. p.1610.
lalia isomorpha Meyr., Proc.Linn.Soc.N.S.Wales,1887,p.845.

ery similar to *E. albicostata*, but slightly larger, more pinkish, less purple-grey tinge. The fillet is fuscous, nearly as dark he face, and this is a good point of distinction from *albicostata*, ch has the fillet white or whitish. The males of the two ies are easily distinguished. Both have a wide range of disution. Walker's type is a female, and without subjecting it ritical examination I cannot of course be sure whether, as Sir . Hampson suggests, it actually is the same as *isomorpha* r., and not *albicostata* Wlk.

Q.: Brisbane, Toowoomba—Vic.: Gisborne—Tasm.: Hobart—S.A.: Mt. Lofty.

10. Eois coercita.

♀. *Acidalia coercita* Luc., Proc. Roy. Soc. Queensland, 1899, p. 140.

♂. 19-20 mm. Head fuscous, fillet whitish; face dark fuscous. Palpi ochreous-fuscous. Antennæ grey, towards base whitish; ciliations 1. Thorax and abdomen pale grey. Legs grey; posterior tibiæ broad and flattened; tarsi broadly ploughshare-shaped, with a large pencil of expansile whitish hairs from inner side of base. Forewings elongate-triangular, costa slightly arched, apex round-pointed, termen slightly sinuate, strongly oblique; uniform pale grey; with three slender whitish-ochreous transverse lines edged posteriorly with darker grey, sometimes scarcely traceable; antemedian sinuate, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; median bowed slightly outwards in middle, from midcosta to $\frac{2}{3}$ dorsum; third somewhat dentate, from $\frac{4}{5}$ costa to tornus; a grey terminal line; cilia grey. Hindwings with termen strongly sinuate; tornus thickened with scales beneath; colour and markings as forewings, but without basal line.

♀. 18-20 mm. Head reddish-fuscous, fillet whitish; face and palpi reddish-fuscous. Antennæ grey, towards base whitish. Thorax and abdomen pale grey. Legs whitish; anterior and middle pairs with some reddish suffusion. Forewings elongate-triangular, costa moderately arched towards apex, apex round-pointed, termen sinuate, oblique; grey-whitish faintly purplish-tinged; costa dull purple-reddish; three well marked whitish-ochreous transverse lines edged posteriorly with grey, corresponding in form and situation to those of ♂; a purple-grey terminal line; cilia reddish. Hindwings with termen evenly bowed; colour and markings as forewings.

The ♀ is an elegant insect; though superficially so dissimilar to the ♂, I believe both sexes belong to the same species.

Type in Coll. Lucas.

N.Q.: Kuranda; in April (Dodd)—Q.: Brisbane; in October, November, and April; in all, four specimens of each sex.

11. Eois liparota,* n.sp.

♂. 18 mm. Head whitish; face and palpi dark fuscous. ntennæ grey, towards base whitish; ciliations in ♂ 1. Thorax d abdomen greenish-grey, smooth and shiny. Legs dark grey; sterior pair in ♂ aborted, closely appressed to abdomen, femora d tibiæ dilated and flattened, tarsi slender, abbreviated ($\frac{1}{3}$). rewings rather elongate-triangular, costa straight, slightly hed towards apex, apex round-pointed, termen scarcely bowed, lique; dull greenish-grey with shining reflections; markings itish-ochreous; a line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; an elongate costal mark before this; a triangular subcostal spot at $\frac{1}{3}$; a e from midcosta to $\frac{2}{3}$ dorsum, slightly bent outwards in disc; irregularly wavy subterminal line; a series of terminal spots, t marked towards apex; cilia grey. Hindwings with termen nded; in ♂ with tornus slightly projecting and thickened h dense scales beneath; colour and markings as forewings.

A very distinct species, its nearest Australian ally being *E. rcita.*

Type in Coll. Turner.

N.Q.: Kuranda; in March; one specimen (Mr. F. P. Dodd).

12. Eois eretmopus,† n.sp.

♂♀. 15-18 mm. Head pale fuscous; fillet whitish, face blackish. pi whitish-ochreous. Antennæ ochreous-whitish; in ♂ filiform, ations $\frac{3}{4}$. Thorax and abdomen ochreous-whitish. Legs itish-ochreous; anterior pair infuscated; posterior tibiæ in ♂ rt and stout, with a large dense tuft of very long hairs spring- from inner side of base; posterior tarsi in ♂ broadly flattened paddle-shaped. Forewings with costa posteriorly moderately hed, hindmargin slightly rounded, oblique; whitish, towards ta ochreous-whitish; first line obsolete or indicated by two or ee blackish dots on veins; median and posterior lines faintly rked, more or less dotted with black on veins; a waved whitish

* λιπαροτος, sleek, shining.

† ἐρετμοπους, paddle-footed.

subterminal line; a broadly interrupted blackish terminal line; cilia whitish. Hindwings with termen rounded; colour and markings as forewings, but basal line absent, and median and posterior lines nearer base.

Closely similar to *E. philocosma* Meyr., but readily distinguished by the extraordinary posterior legs of the male.

Type in Coll. Turner.

Q.: Brisbane, Mt. Tambourine, and Toowoomba; from February to April, and in November; nine specimens.

13. Eois elaphrodes,* n.sp.

♂♀. 13-15 mm. Head fuscous-whitish; fillet whitish; face dark fuscous. Palpi fuscous. Antennæ ochreous-whitish; ciliations in ♂ 1. Thorax and abdomen ochreous-whitish with a few fuscous scales. Legs ochreous-whitish; anterior pair slightly infuscated; posterior pair in ♂ with tibiæ moderately long, clothed with hairs above, ending in an apical tuft, with a pencil of long hairs from inner side of base; posterior tarsi slender, moderately long ($\frac{1}{2}$). Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; ochreous-whitish with a few scattered fuscous scales; lines pale fuscous; a dark fuscous discal dot beyond middle; antemedian line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, outwardly curved; a sinuate median line from $\frac{2}{3}$ costa to mid-dorsum; a finely dentate postmedian line from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; faintly suffused subterminal and submarginal lines; cilia whitish with a basal series of dark fuscous dots. Hindwings with termen rounded; colour and markings as forewings.

The terminal dots are situated in the cilia in this species.

Type in Coll. Turner.

N.Q.: Kuranda; in August and October; five specimens.

14. Eois dolichopis,† n.sp.

♂♀. 22-29 mm. Head pale fuscous; fillet whitish; face and palpi dark fuscous. Antennæ whitish; in ♂ serrate towards

* ἐλαφρώδης, of light appearance.

† δολιχωπις, appearing long.

pex, ciliations 1. Thorax and abdomen ochreous-whitish. Legs chreous-whitish; anterior pair mixed with dark fuscous; osterior tibiæ in ♂ well developed, broad, laterally compressed, ough-scaled, without spurs; posterior tibiæ in ♀ with middle urs wanting; posterior tarsi in ♂ very short, $\frac{1}{5}$. Forewings ongate-triangular, costa slightly arched, termen bowed, very lique; ochreous-whitish, with pale greyish lines; basal line and scal dot obsolete; median very oblique from middle of inner argin, obsolete towards costa; postmedian line from costa at $\frac{5}{6}$ inner margin at $\frac{3}{4}$, dotted with fuscous on veins; subterminal d submarginal cloudy; cilia ochreous-whitish. Hindwings th termen sinuate; 6 and 7 stalked; colour and markings as rewings.

The largest Australian species. Of ordinary facies, distin-ishable by the shape of the fore- and hindwings, but the hind biæ of the male are of the form characteristic of several of the nus *Leptomeris*.

Type in Coll. Turner.

Q.: Bundaberg, Brisbane; three specimens in April.

ction ii. *Hind tibiæ and tarsi of ♂ slender, abbreviated* (Eois).

15. Eois ferrilinea.

is ferrilinea Warr., Nov. Zool. 1900, p.106.

My specimen is in poor condition, but agrees with the type in oll. Rothschild, with which it has been compared.

Q.: Duaringa; Stanthorpe, in January, one specimen.

16. Eois cletima,* n.sp.

♂♀. 12-15 mm. Head and thorax whitish, faintly tinged with ddish-orange, with a few blackish scales; face and palpi dark scous. Antennæ whitish, in ♀ sometimes fuscous except wards base; in ♂ serrated, ciliations $\frac{3}{4}$. Abdomen whitish ixed with fuscous. Legs whitish; anterior pair infuscated; in

* κλητιμος, worth choosing.

♂ posterior pair minute, tarsi slender, $\frac{3}{5}$; in ♀ posterior tibiæ without middle spurs. Forewings with costa slightly arched, apex rounded, termen rounded, oblique; whitish, faintly tinged with reddish-orange and irrorated with fuscous and dark fuscous, some scales showing dull metallic reflections; costa fuscous except shortly before apex; an outwardly curved, somewhat dentate, dark fuscous, basal line from costa at $\frac{1}{5}$ to inner margin at $\frac{1}{4}$; a reddish-orange median line irrorated with dark fuscous, especially towards costa; followed by a circular dark fuscous discal spot; postmedian line slightly outwardly curved, somewhat dentate, from costa at $\frac{3}{5}$ to inner margin at $\frac{3}{4}$; followed by two dark fuscous blotches in disc representing subterminal; submarginal represented by a grey suffusion; cilia with basal half reddish-ochreous-whitish barred with dark fuscous, terminal half grey. Hindwings with termen rounded; colour and markings as forewings.

A variable species as regards the degree of fuscous irroration.

Type in Coll. Turner.

N.Q.: Townsville; four specimens in April, May, and July; my three finest examples of this delicate and beautiful species I owe to Mr. F. P. Dodd—Q.: Brisbane, in December; one female specimen with the orange markings mostly obsolete.

17. Eois albicostata.

Acidalia albicostata Wlk., Brit. Mus. Cat. xxiii. p.779; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.844.

Type in British Museum.

Q.: Duaringa, Brisbane, Stradbroke Island, Toowoomba, Stanthorpe—N. S.W.: Glen Innes, Sydney, Bathurst, Mt. Kosciusko—Tasm.: Launceston, Deloraine. Also from New Guinea (Meyrick).

18. Eois halmaea.

Acidalia halmaea Meyr., Proc. Linn. Soc. N.S.Wales, 1887, p.846.

This species shows considerable variability, and I at one time divided it into two. The termen of forewings is sometimes

slightly sinuate beneath apex. The wings vary in the degree of reddish suffusion, and the forewings in the presence or absence of suffused greyish blotches on termen and tornus. An occasional variety has a broad median grey band across both wings.

Type in Coll. Meyrick.

Q.: Nambour, Brisbane, Mt. Tambourine, Toowoomba—N.S.W.: Sydney, Bulli, Kiama —Vic.: Gisborne—Tasm.: George's Bay.

19. Eois scintillans.

Ptychopoda scintillans Warr., Nov. Zool. 1898, p.243.

I have no example of this species, but have examined the type in Coll. Rothschild. It is a male with minute hind legs, which appear to have been overlooked by its describer, as they are stated to be absent.

Q.: Duaringa; in September.

20. Eois fucosa.

Eois fucosa Warr., Nov. Zool. 1900, p.106.

♂. 13-14 mm. Head, thorax, and abdomen ochreous-whitish. Face and palpi dark fuscous. Antennæ ochreous-whitish; in ♂ serrate and ciliated in tufts, ciliations 2½. Legs ochreous-whitish; anterior pair infuscated; posterior tibiæ in ♂ very small, not dilated; posterior tarsi in ♂ 1. Forewings with costa moderately arched towards apex, apex rounded, termen obliquely rounded; whitish, with six wavy transverse pale ochreous lines; cilia ochreous-whitish. Hindwings with hindmargin rounded; colour and markings as forewings.

A small, delicate, and inconspicuous species, but very distinct in the pale rippled ochreous markings, absence of fuscous scales, and antennæ of male.

Type in Coll. Rothschild.

N.Q.: Cairns and Townsville; in March, May, June, and August; six specimens.—Q.: Rockhampton (Warren).

21. Eois problеta,* n.sp.

♂. 21 mm. Head ochreous-whitish; face dark fuscous. Palpi ochreous-whitish mixed with dark fuscous. Antennæ ochreous-whitish; in ♂ with moderate ciliations (1½). Thorax and abdomen ochreous-whitish. Legs ochreous-whitish; anterior pair fuscous; posterior pair in ♂ minute, tibiæ very small and slender, tarsi ½, slender. Forewings triangular, costa with basal half nearly straight, then strongly arched, apex round-pointed, termen bowed, oblique; ochreous-whitish suffused with pale grey; an ochreous-whitish costal streak from base nearly to apex; costal edge reddish; a fuscous dot on median and another on dorsum at ⅓, representing antemedian line; traces of a median line; postmedian represented by a series of minute fuscous dots on veins, from ⅘ costa to ¾ dorsum, sinuate; suffused wavy greyish subterminal and submarginal lines; a grey terminal line interrupted on veins; cilia whitish with some obscure basal greyish dots. Hindwings with termen rounded, strongly projecting between veins 2 and 5; colour and markings as forewings, but antemedian and postmedian faintly indicated by grey lines.

Nearest *E. nephelota*, from which it is best distinguished by the reddish costal edge of forewings, and the form of termen of hindwings.

Type in Coll. Lyell.

Vic.: Lorne; in February; one specimen (Mr. G. Lyell).

22. Eois nephelota,† n.sp.

♂♀. 17-18 mm. Head fuscous, fillet ochreous-whitish, face blackish. Palpi ochreous-fuscous. Antennæ ochreous-whitish. Abdomen ochreous-whitish. Legs ochreous-whitish; anterior pair irrorated with fuscous; posterior tibiæ in ♂ minute, tarsi ½. Forewings with costa straight, posteriorly somewhat arched, hindmargin slightly bowed, oblique; ochreous-whitish, partly

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* προβλητος, projecting; in allusion to the hindwings.

† νεφελωτος, cloudy.

suffused with purplish-grey; a whitish streak along costa; basal line obsolete; median distinct, fine, grey, acutely dentate, from near costa at $\frac{2}{3}$ to middle of dorsum; posterior line represented by a series of dark fuscous dots; subterminal broad, cloudy, purplish-grey, anteriorly ill-defined, posteriorly dentate, sharply edged by a fine ochreous-whitish line; a fine interrupted blackish hindmarginal line; cilia whitish. Hindwings with termen rounded; colour and markings as forewings.

Type in Coll. Lyell.

Vic.: Gisborne, in January and February; two specimens.

23. Eois pseliota.*

Acidalia pseliota Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p 848.

Type in Coll. Meyrick.

Q.: Brisbane; in October; one specimen—Vic.: Melbourne; Gisborne, in November, one specimen (Mr. G. Lyell).

24. Eois pachydetis.†

Acidalia pachydetis Meyr., Proc.Linn.Soc.N.S.Wales,1887,p.847.

Type in Coll. Meyrick.

W.A.: Perth.

25. Eois philocosma.‡

Acidalia philocosma Meyr., Proc.Linn.Soc.N.S.Wales,1887,p.845.
Ptychopoda punctatissima Warr., Nov. Zool. 1901, p.25.

Type in Coll. Meyrick.

N.Q.: Townsville—Q.: Brisbane, Stradbroke Island, Toowoomba, Warwick—N.S.W.: Tenterfield, Ben Lomond, Sydney, Katoomba—Vic.: Melbourne, Gisborne, Birchip—Tasm.: George's Bay.

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* ψελιωτος, wearing a bracelet.

† παχυδετις, thickly bound or bordered.

‡ φιλοκοσμος, fond of ornament.

Species of which the ♂ is undescribed.

26. Eois plumboscriptaria.*

Acidalia plumboscriptaria Christ., Bull. Mosc. 1880 (2), p.44.
Eois plumboscriptaria Meyr., Trans. Ent. Soc. 1897, p.376.

N.A.: Port Darwin; one imperfect specimen in Coll. Lyell. —Q.: Duaringa (Meyrick).

27. Eois iodesma.

Eois iodesma Meyr., Trans. Ent. Soc. 1897, p.376.

This species is unknown to me.

Type in Coll. Meyrick.

Q.: Brisbane (*loc. cit.*), but probably the exact locality is Southport.

28. Eois alopecodes.†

Acidalia alopecodes Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.846.

Type in Coll. Meyrick.

W.A.: Geraldton.

29. Eois polygramma.

Eois polygramma Low., Trans. Roy. Soc. S. Aust. 1902, p.249.

♀. Fillet white. Thorax and abdomen white. Forewings white, with a few scattered dark fuscous scales towards base, and five dentate or wavy ochreous-grey transverse lines; an interrupted grey line close to termen; cilia whitish. Hindwings with colour and markings as forewings, but without basal line.

Type in Coll. Lower.

N.Q.: Cooktown (Lower).

30. Eois stenozona.

Eois stenozona Low., Trans. Roy. Soc. S. Austr. 1902, p.248.

Face blackish. Head, antennæ, thorax, and abdomen ochreous-whitish. Forewings ochreous-whitish sparsely irrorated with

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* *Plumbum*, lead; *scriptus*, written, lined.

† ἀλωπεκώδης, like a fox, foxy-red.

dark fuscous; a well marked dark fuscous, dentate, postmedian line from $\frac{5}{6}$ costa to $\frac{3}{4}$ dorsum. Hindwings with similar coloration and postmedian line.

Type in Coll. Lower.

N.S.W.: Broken Hill (Lower).

Gen.4. LEPTOMERIS.

Leptomeris Hb., Verz. p.310; Meyr., Trans. Ent. Soc. 1902, p.89.
Craspedia Hb., Verz. p.312; Hmps., Moths Ind. iii. p.426.

Face smooth. Palpi obliquely ascending, moderate or rather short, second joint closely appressed to or sometimes slightly exceeding frons, terminal joint minute. Antennæ in ♂ serrate, shortly laminate or simple, with moderate or rather long ciliations. Posterior tibiæ in ♂ without spurs, often dilated, in ♀ with all spurs present; posterior tarsi in ♂ more or less abbreviated. Forewings with 7, 8, 9, 10 stalked, 11 anastomosing shortly with their common stalk, forming a single areole. Hindwings with 5 from middle of cell, 6 and 7 short-stalked or separate.

The species are numerous, most of them very similar, and require careful discrimination. Special attention should be paid to the structure of the hindlegs of the ♂, which in many instances is the most valuable distinguishing character. The Australian species fall naturally into two sections, of which the first contains the great majority.

The following species are unavoidably omitted from the tabulation, and must be consulted separately: *L. despoliata* Wlk., *didymosema* Low., *hypocallista* Low., *tetrasticha* Low., *castissima* Warr.

1.	Posterior tibiæ of ♂ more or less dilated..................	2.
	Posterior tibiæ of ♂ slender..................................	19.
2.	Posterior tarsi of ♂ more than $\frac{1}{2}$ tibiæ............................	3.
	Posterior tarsi of ♂ less than $\frac{1}{2}$ tibiæ............................	8.
3.	Face ochreous-whitish or ochreous-greyish....................	31. *lydia*.
	Face ferruginous-whitish..	32. *neoxesta*.
	Face dark fuscous or blackish....................................	4.

4.	Cilia irrorated with dark fuscous	5.
	Cilia not irrorated with dark fuscous	6.
5.	Posterior tarsi of ♂ nearly as long as tibiæ	33. *hypochra.*
	Posterior tarsi of ♂ ⅔ tibiæ	34. *axiotis.*
6.	Termen of hindwings angulated in middle	35. *perlata.*
	Termen of hindwings rounded	7.
7.	Termen of forewings strongly oblique	36. *lechrioloma.*
	Termen of forewings only moderately oblique	37. *liotis.*
8.	Forewings grey with slender, acutely dentate postmedian line	38. *desita.*
	Postmedian line of forewings without long acute dentations	9.
9.	Wings ochreous-reddish	39. *rubraria.*
	Wings whitish or ochreous-whitish	10.
10.	Posterior tarsi of ♂ about ⅓	11.
	Posterior tarsi of ♂ ⅕ or less	16.
11.	Face brownish-ochreous	40. *chloristis.*
	Face dark fuscous or blackish	12.
12.	Wings with ground-colour whitish	41. *aleuritis.*
	Wings with ground-colour ochreous-whitish or grey-whitish	13.
13.	Postmedian line of both wings marked with blackish dots	42. *sublinearia.*
	Postmedian line without blackish dots	14.
14.	Wings greyish with many scattered blackish scales	43. *prosoeca.*
	Wings whitish or ochreous-whitish with few blackish scales	15.
15.	Termen of hindwings strongly bowed, with slight median projection	44. *recessata.*
	Termen of hindwings rounded	45. *coenona.*
16.	Termen of hindwings with median tooth	46. *nictata.*
	Termen of hindwings rounded	17.
17.	Cilia with two distinct dark lines	47. *oppilata.*
	Cilia without two dark lines	18.
18.	Posterior tibiæ of ♂ more strongly dilated in basal half, with two tassels at base	48. *thysanopus.*
	Posterior tibiæ of ♂ more strongly dilated in distal half, without tassels	49. *optivata.*
19.	Wings ochreous-whitish	50. *cæsaria.*
	Wings with ground-colour pure white	51. *innocens.*

Section i. *Posterior tibiæ of ♂ more or less dilated.*

31. Leptomeris lydia.

Idæa lydia Butl., Trans. Ent. Soc. 1886, p.435 : *Idæa jessica* Butl., Trans. Ent. Soc. 1886, p.436 : *Acidalia lydia* Meyr., Proc. Linn. Soc. N. S.Wales, 1887, p.851.

Type in British Museum.

Q.: Peak Downs, Duaringa, Brisbane, Dalby, Warwick, Miles, Cunnamulla—N.S.W.: Sydney, Broken Hill—Vic.: Melbourne —S.A.: Mt. Lofty—W.A.: Geraldton, Carnarvon.

32. Leptomeris neoxesta.

Acidalia neoxesta Meyr., Proc. Linn. Soc. N.S.Wales, 1887, p.850.

Type in Coll. Meyrick. This species is unknown to me.

Q.: Duaringa.

33. Leptomeris hypochra.

Acidalia hypochra Meyr., Proc. Linn. Soc. N.S.Wales,1887, p.848.

Type in Coll. Meyrick.

N.Q.: Thursday I., Cooktown, Kuranda, Townsville, Ravenswood—Q.: Duaringa, Nambour, Brisbane, Stradbroke Island, Southport—N.S.W.: Sydney—S.A.: Mt. Lofty.

34. Leptomeris axiotis.

Acidalia axiotis Meyr., Proc. Linn. Soc. N.S.Wales, 1887, p.855.

This species is unknown to me. The localities were accidentally omitted in Mr. Meyrick's paper, but he has given me leave to publish them.

Type in Coll. Meyrick.

W.A.: York, Geraldton.

35. Leptomeris perlata.

Acidalia perlata Wlk., Brit. Mus. Cat. xxiii., p.776; Meyr., Proc. Linn. Soc. N.S.Wales, 1887, p.860.

The only species likely to be confused with this is *L. recessata*, which differs in the slighter median prominence of hindwings,

paler ground-colour, less oblique median line of forewings, and especially in the shorter posterior tarsi of the male.

Type in British Museum.

Q.: Nambour, Mt. Tambourine, Bunya Mountains—N.S.W.: Sydney, Kiama, Jenolan—Vic.: Gisborne—Tasm.: Mt. Wellington.

36. Leptomeris lechrioloma,* n.sp.

♂. 18-19 mm. Head pale fuscous; fillet broadly white; face and palpi dark fuscous. Antennæ white; in ♂ very shortly laminate, with rather long cilia (2). Thorax and abdomen whitish. Legs whitish, anterior and middle pairs more or less suffused with pale fuscous; posterior tibiæ in ♂ slight, dilated towards apex, with a fine pencil of long hairs from inner side of base, tarsi ¾. Forewings elongate-triangular, costa gently arched, apex round-pointed, termen bowed, strongly oblique; white, with a very few scattered fuscous scales; a blackish median discal dot; lines very pale fuscous; antemedian line obsolete; median, postmedian, subterminal, and submarginal lines straight, parallel to termen; a terminal series of blackish dots; cilia white. Hindwings with termen gently rounded; colour and markings as forewings.

Type in Coll. Turner.

N.Q.: Kuranda, in August and October; three specimens (Mr. F. P. Dodd).

37. Leptomeris liotis.

Acidalia compensata Wlk., Brit. Mus. Cat. xxiii. 777, *præocc.* ibid. xxii. 724; *Acidalia liotis* Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.854.

Type in British Museum.

N.S.W.: Mt. Kosciusko—Vic.: Mt. Hotham (Drake). According to Walker, also from Tasmania.

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* λεχριολωμος, with oblique edge.

38. Leptomeris desita.

Tephrosia desita Wlk., Brit. Mus. Cat. xxi. p.421; *Acidalia desita* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.850; *Acidalia vibrata* Luc., Proc. Roy. Soc. Queensland, 1899, p.141.

Type in British Museum.

N.Q.: Cairns, Kuranda—Q: Duaringa, Nambour, Brisbane, Toowoomba—N. S. W.: Sydney.

39. Leptomeris rubraria.

Ptychopoda rubraria Dbld., Dieff. N.Z. ii. p.286; *Acidalia figlinaria* Gn., Lep. ix. p.454, pl.xii. f.8; *Acidalia repletaria* Wlk., Brit. Mus. Cat. xxiii. p.778; *Acidalia attributa* Wlk., Brit. Mus. Cat. xxiii. p.779; *Fidonia* (?) *acidaliaria* Wlk., Brit. Mus. Cat. xxiv. p.1037; *Acidalia rubraria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.852.

Q.: Peak Downs, Duaringa, Nambour, Brisbane, Stradbroke Isld., Mt. Tambourine, Toowoomba, Nanango, Stanthorpe, Adavale—N.S.W.: Tenterfield, Ben Lomond, Glen Innes, Sydney, Katoomba, Bathurst, Moruya—Vic.: Sale, Melbourne, Springvale—Tasm.: Launceston, George's Bay, Hobart—S.A.: Mt. Lofty, Pt. Lincoln—W.A.: Albany. Abundant everywhere. Also from Norfolk Island and New Zealand.

40. Leptomeris chloristis.

Acidalia chloristis Meyr., Proc. Linn. Soc. N.S.Wales, 1887, p.849.

Type in Coll. Lucas. This species is unknown to me.

Queensland; exact locality unknown.

41. Leptomeris aleuritis,* n.sp.

♂♀. 18-20 mm. Head ochreous-fuscous; fillet white; face and palpi dark fuscous. Antennæ whitish; in ♂ simple, ciliations 1. Thorax and abdomen white. Legs ochreous-whitish; anterior pair pale fuscous; posterior tibiæ in ♂ evenly dilated, smooth-

* ἀλευριτις.

scaled, hairy on upper surface posteriorly; posterior tarsi in ♂ $\frac{2}{5}$. Forewings with costa slightly arched near apex, termen bowed, slightly oblique; whitish without ochreous tinge, with a very few scattered fuscous scales; lines pale ochreous-grey; postmedian and median line sometimes scarcely indicated; a blackish discal dot; postmedian line fine, denticulate, outwardly curved, from costa at $\frac{5}{6}$ to dorsum at $\frac{3}{4}$; subterminal and submarginal sometimes obsolete; a series of blackish terminal dots; cilia whitish. Hindwings with termen rounded; 6 and 7 connate; colour and markings as forewings.

Type in Coll. Turner.

N.Q.: Geraldton and Townsville; in February, April, and May; eight specimens.

42. Leptomeris sublinearia.

Acidalia sublinearia Wlk., Brit. Mus. Cat. xxxv. p.1632; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.858.

The wings vary from grey-whitish to grey.

Type in British Museum.

N.Q.: Cairns, Atherton, Townsville—Q.: Duaringa, Brisbane, Stradbroke Isld., Toowoomba—W.A.: Geraldton.

43. Leptomeris prosoeca, n.sp.

♂♀. 20-25 mm. Head fuscous-whitish; fillet whitish; face and palpi blackish. Antennæ whitish; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen grey-whitish, with a few scattered black scales. Legs fuscous, posterior pair whitish; posterior tibiæ in ♂ much dilated, rough-scaled on upper edge, tarsi $\frac{2}{5}$. Forewings triangular, termen bowed; grey-whitish with sparsely scattered black scales; lines grey; antemedian line nearly obsolete; median usually distinct, suffused, oblique, from $\frac{2}{3}$ costa to mid-dorsum; preceded by a blackish discal dot; postmedian fine, denticulate, from $\frac{5}{6}$ costa to $\frac{3}{4}$ dorsum; subterminal and submarginal faint, closely parallel; a series of fine terminal black dots between veins; cilia grey-whitish, towards base more or less irrorated with black scales. Hindwings with termen rounded; colour and markings

as forewings, but antemedian line obsolete, and median line preceding discal dot.

Closely allied to *L. optivata* Wlk., from which it may be distinguished by the more greyish colouring and the black dots on cilia, together with the relatively longer tarsi of ♂.

Type in Coll. Turner.

N.Q.: Townsville; in April, May, June, and July; five bred specimens and others received from Mr. F. P. Dodd.

44. LEPTOMERIS RECESSATA.

Acidalia recessata Wlk., Brit. Mus. Cat. xxiii. p.777; *nec* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.856.

♂♀. 21-26 mm. Head fuscous-whitish; fillet white; face and palpi dark fuscous. Antennæ whitish; ciliations in ♂ 1½. Thorax and abdomen whitish, with a very few blackish scales. Legs whitish; anterior pair pale fuscous; posterior tarsi of ♂ ½. Forewings triangular, costa straight for ⅔, then bowed to apex, apex round-pointed, termen bowed, oblique; whitish with a few scattered blackish scales; lines grey or pale fuscous; antemedian line oblique, from ¼ dorsum, not reaching costa, sometimes obsolete; a blackish median discal dot; median line slightly outwardly curved, wavy, from ⅔ costa to mid-dorsum; postmedian line dentate from ⅘ costa to ¾ dorsum; subterminal and submarginal similar but less distinct; a terminal series of black dots; cilia whitish, rarely with a few blackish scales. Hindwings with termen strongly bowed and with an angle, or slightly projecting, on vein 4; colour and lines as forewings, but without basal line, and with discal dot on or just before or after median line.

The longer posterior tarsi of the ♂ and the angulated hindwings distinguish this from *L. optivata*, but the posterior tarsi are much shorter and the angulation less marked than in *perlata*. I think this species, which corresponds to Walker's type in the British Museum, was unknown to Mr. Meyrick.

N.Q.: Thursday Island, Kuranda, Geraldton, Townsville—Q.: Stradbroke Island, Mount Tambourine, Toowoomba.

45. Leptomeris coenona, n.sp.

♂. 20 mm. Head pale fuscous; fillet whitish; face blackish. Palpi blackish, anterior edge whitish. Thorax and abdomen ochreous-whitish. Legs whitish; anterior pair fuscous anteriorly; posterior tibiæ of ♂ somewhat elongate, slightly dilated, flattened and twisted, with a pencil of long hairs from base, and a tuft of hairs on outer side of apex; tarsi $\frac{3}{5}$. Forewings ochreous-whitish with a very few scattered black scales; lines pale grey; a faint antemedian line; a minute black discal dot; a faint median line from $\frac{2}{3}$ costa to mid-dorsum; a finely denticulate postmedian line from $\frac{4}{5}$ costa to $\frac{3}{4}$ dorsum; distinct wavy subterminal and submarginal lines; a series of minute terminal black dots between veins; cilia ochreous-whitish. Hindwings with termen rounded; colour and markings as forewings, but antemedian line and discal dot obsolete.

Type in Coll. Turner.

N.Q.: Townsville, in May; one specimen.

46. Leptomeris nictata.

Acidalia nictata Gn., Lep.ix.(*teste* Hmps.,Moths Ind. iii. p.428): *Acidalia ligataria* Wlk., Brit. Mus. Cat. xxii. p.748; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.860: *Acidalia deliciosaria* Wlk., Brit. Mus. Cat. xxiii. p.791; *Acidalia dimorphata* Snel.,Tijdsch. v. Ent. 1881, p.81, pl.x. f.6; *Idæa agnes* Butl., Trans. Ent. Soc. 1886, p.437.

This is a variable species. *L. dimorphata* Snel., = *agnes* Butl., is a form with groundcolour of wings white and antemedian line of forewings obsolete.

Q.: Rockhampton, Duaringa, Bundaberg. Also from New Guinea, Celebes, Formosa, Ceylon, and India.

47. Leptomeris oppilata.

Acidalia oppilata Wlk., Brit. Mus. Cat. xxiii. p.776; *Acidalia stipataria* Wlk., Brit. Mus. Cat. xxiii. p.779; *Acidalia crossophragma* Meyr., Trans. Ent. Soc. 1886, p.206, and Proc. Linn. Soc. N. S. Wales, 1887, p.859.

I have examined Walker's types in the British Museum, and have no doubt as to their identity with Meyrick's species.

N.Q.: Thursday Island, Townsville—Q.: Duaringa, Peak Downs, Gympie, Brisbane, Rosewood, Toowoomba, Dalby, Miles, Cunnamulla—N.S.W.: Tenterfield, Sydney. Also from New Guinea.

48. Leptomeris thysanopus,* n.sp.

♂♀. 17 mm. Head fuscous-whitish, fillet whitish; face blackish. Palpi whitish; upper surface and apex blackish. Antennæ whitish with some dark fuscous scales; apical portion in ♂ greyish; in ♂ simple, ciliations 1. Thorax and abdomen ochreous-whitish; the latter with one or two blackish scales. Legs whitish; anterior pair fuscous; posterior tibiæ of ♂ elongate and somewhat dilated, especially near base, smooth-scaled, with two long processes from apex of knee, each expanding half-way into a tuft of long hairs; posterior tarsi of ♂ $\frac{1}{5}$. Forewings with costa moderately arched near apex, apex rounded; termen slightly rounded, oblique; ochreous-whitish, with a very few scattered blackish scales; lines very faint ochreous; antemedian straight, from beneath costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$; a minute black discal dot well before median; median nearly straight from costa at $\frac{2}{3}$ to middle of dorsum; posterior straight, dentate, from costa at $\frac{4}{5}$ to dorsum at $\frac{3}{4}$; subterminal and submarginal wavy; a series of terminal black dots; cilia whitish-ochreous. Hindwings with termen rounded; 6 and 7 connate; colour and markings as forewings, but basal line absent, and discal dot on or just posterior to median.

Characterised by the remarkable tassellated appendages to the posterior tibiæ of the male, also by the short antennal ciliations and absence of blackish scales from cilia.

Type in Coll. Turner.

N.Q.: Cardwell and Townsville; four specimens (one ♂, three ♀) in August and September.

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* θυσανοπους, tassel-footed.

49. Leptomeris optivata.

Acidalia optivata Wlk., Brit. Mus. Cat. xxiii. p.780; Meyr., Proc.Linn.Soc.N.S. Wales, 1887, p.857: *Acidalia recessata* Meyr., Proc.Linn.Soc.N.S.Wales, 1887, p.856, *nec* Wlk.: ?*Acidalia homodoxa* Meyr., Trans. Ent. Soc. 1886, p.208.

A widely distributed species common everywhere. I regard the two forms described by Mr. Meyrick as varieties, but the type of *recessata* Wlk., is a distinct species. I have received specimens identified as *homodoxa* Meyr., but doubt if they are anything more than a local form. Mr. Meyrick gives length of posterior tarsi in ♂ as $\frac{1}{3}$, but this may be a misprint for $\frac{1}{5}$.

Ab. *amathodes*. Two male specimens structurally identical with this species, but with wings brownish and markings obsolete. They are from Lancefield Junction, Victoria.

Ab. *polia*. Head, thorax, abdomen, and wings grey. Vic.: Birchip; one ♂ in Coll. Goudie.

Type in British Museum.

N.A.: Port Darwin (*homodoxa*)—N.Q.: Cooktown, Townsville, Mackay—Q: Gympie, Nambour, Brisbane, Mt. Tambourine, Toowoomba, Nanango, Stanthorpe, Miles—N.S.W.: Tenterfield, Glen Innes, Ben Lomond, Sydney, Kiama—Vic.: Melbourne, Gisborne—S.A.: Mt. Lofty—Tasm.: Hobart, Deloraine—W.A.: Albany, Geraldton.

Section ii. *Posterior tibiæ of ♂ slender.*

50 Leptomeris caesaria.

Acidalia cæsaria Wlk., Brit. Mus. Cat. xxiii. p.750; Meyr., Proc. Linn.Soc.N.S.Wales, 1887, p.853: *Acidalia obturbata* Wlk., Brit. Mus. Cat. xxiii. p.755.

Type in British Museum.

N.Q.: Townsville—Q.: Duaringa. Also from Ceylon.

51. Leptomeris innocens.

Idæa innocens Butl., Trans. Ent. Soc. 1886, p.436; *Acidalia innocens* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.843.

The posterior tibiæ of ♀ have two pairs of spurs. The median e in both wings may be well developed or obsolete.

Type in British Museum.

N.Q.: Mareeba—Q.: Rockhampton, Duaringa, Brisbane.

Unclassified Species.

52. LEPTOMERIS DESPOLIATA.

dalia despoliata Wlk., Brit. Mus. Cat. xxiii. p.778.

♀. 21 mm. Head fuscous-whitish; fillet whitish; face dark cous. Palpi fuscous. Antennæ whitish. Thorax and abdo-n ochreous-whitish; the latter with a few scattered blackish les. Legs ochreous-whitish; anterior pair mostly fuscous. ewings with costa slightly arched, termen slightly nded, oblique; ochreous-whitish, with sparsely scattered kish scales; lines faint ochreous, cloudy, straight, parallel; emedian line scarcely perceptible; a minute black discal dot ore median; median from $\frac{2}{3}$ of costa to middle of dorsum; post-lian from $\frac{4}{5}$ of costa to $\frac{3}{4}$ of dorsum; subterminal and sub-ginal similar; a terminal series of transversely elongate kish dots; cilia ochreous-whitish. Hindwings with hind-gin rounded, towards anal angle straight; 6 and 7 connate; ur and markings as forewings, but basal line absent, and al dot on median.

haracterised by the straight cloudy transverse lines, especially he posterior line which is denticulate in allied species. The may show additional characters. Walker's type in the ish Museum has scarcely any blackish irroration.

.: Stradbroke Island; one specimen.

53. LEPTOMERIS HYPOCALLISTA.

omeris hypocallista Low., Proc. Linn. Soc. N. S.Wales, 1900, p.405.

ead, face, thorax, and abdomen brownish-ochreous. Fore-gs brownish-ochreous; costa and three faint wavy transverse s reddish-purple; a dot above mid-disc following first line, and

a series of terminal dots, reddish mixed with dark fuscous; cilia reddish-purple, apices mixed with dark fuscous. Hindwings with termen rounded; colour like forewings, but brighter; markings as forewings, but basal line absent, and other lines less marked.

Type in Coll. Lower.

S.A.: Goolwa (Lower).

54. Leptomeris didymosema.

Acidalia didymosema Low., Trans.Roy.Soc.S.Aust.1893,p.156.

Head, face, thorax, and abdomen brownish-ochreous. Forewings brownish-ochreous; a transverse darker line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; a dot in mid-disc; a postmedian sigmoid line from $\frac{3}{4}$ costa to $\frac{3}{5}$ dorsum; a dark brown terminal line; cilia brownish. Hindwings as forewings, but lines indistinct.

Type in Coll. Lower.

S.A.: Adelaide (Lower).

55. Leptomeris tetrasticha.

Leptomeris tetrasticha Low., Trans. Roy. Soc. S.Aust. 1902, p.250.

Face blackish. Thorax and abdomen whitish irrorated with dark fuscous. Forewings whitish, sparsely irrorated with grey and blackish scales; a dark grey dot in disc above middle; three postmedian transverse lines of grey dots; a series of blackish subterminal dots; cilia whitish mixed with dark fuscous. Hindwings with termen rounded; colour and markings as forewings.

Type in Coll. Lower.

N.W.A.: Derby (Lower).

56. Leptomeris castissima.

Craspedia castissima Warr., Nov. Zool. 1897, p.51.

I have seen only the type, which is in Coll. Rothschild. It resembles *sublinearia* Wlk., but appears to be distinguishable by lower half of face being whitish. There is a specimen in the British Museum from New Guinea.

N.Q.: Cooktown.

Gen.5. DASYBELA,*.nov.

Face smooth. Palpi moderate, subascending, clothed anteriorly ith long, stiff, diverging hairs. Antennæ in ♂ serrate, with scicles of moderately long cilia. Thorax and coxæ hairy neath. Posterior tibiæ in ♂ without middle spurs; [in ♀ iknown]. Forewings with 7, 8, 9, 10 stalked, 11 anastomosing ry shortly with their common stalk. Hindwings with 5 from ove middle of discocellulars, strongly approximated to 6, 6 and d 7 separate.

Probably a development of *Pylarge*, from which it differs in e long rough hairs on palpi and underside of thorax. The proximation of vein 5 of hindwings to vein 6 at base is quite strong as in the *Geometrinæ*, but the natural affinities of the nus place it in this neighbourhood.

57. DASYBELA ACHROA.

umiltis achroa Low., Trans. Roy. Soc. S.Aust. 1902, p.229.

♂. 18-19 mm. Head and palpi whitish-ochreous with some ·k fuscous scales; palpi 1½. Antennæ whitish-ochreous; in ♂ ongly serrate (⅔) with fascicles of long cilia (1½). Thorax and lomen blackish with whitish-ochreous irroration. Legs itish-ochreous; femora and anterior tibiæ mixed with dark cous. Forewings rather elongate-triangular, costa straight, uptly curved near apex, apex rounded, termen bowed, oblique; wn-whitish with dark fuscous markings and irroration; a ce angulated antemedian line from ¼ costa to ⅓ dorsum; a dian line, somewhat dentate, thickened on costa; followed ards costa by a discal dot; a finely dentate postmedian line m ¾ costa to ⅘ dorsum, thickened on costa; a dark subterminal fusion; a series of black terminal dots separated by ochreous-itish; cilia ochreous-whitish. Hindwings with termen strongly nded; colour and markings as forewings but without basal e.

* δασυβηλος, with hairy weapons (palpi).

Type in Coll. Lyell.

Tasm.: Hobart, in February; three specimens.

Gen. 6. PYLARGE.

Pylarge H. Sch.; Meyr., Brit. Lep. p.244.

Face smooth. Palpi moderate, subascending. Antennæ in ♂ ciliated with fascicles. Thorax smooth beneath. Femora smooth. Posterior tibiæ in ♂ not dilated, with terminal spurs only, in ♀ with two pairs of spurs. Forewings with 10 out of 9, 11 connected or anastomosing with 9. Hindwings with 6 and 7 separate or stalked.

Type

A small genus containing one European species.

1.	Thorax dark grey	58. *episcia*.
	Thorax whitish	2.
2.	Forewings with blackish dots on costa	59. *erebospila*.
	Forewings without blackish costal dots	3.
3.	Hindwings with termen almost straight	60. *proxima*.
	Hindwings with termen rounded	4.
4.	Forewings with discal dot large, postmedian line subsinuate	63. *megalocentra*.
	Forewings with discal dot minute, lines straight	5.
5.	Antennæ of ♂ with ciliations 2½	62. *orthoscia*.
	Antennæ of ♂ with ciliations 1½	61. *loxosema*.

58. PYLARGE EPISCIA.

Acidalia episcia Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.863.

Type in Coll. Meyrick.

N.S.W.: Broken Hill—W.A.: Carnarvon.

59. PYLARGE EREBOSPILA.

Pylarge erebospila Low., Trans. Roy. Soc. S. Aust. 1902, p.250.

♂. Head, face, thorax, and abdomen ochreous-whitish. Antennæ ochreous-whitish, towards base annulated with blackish. Forewings elongate-triangular, costa straight almost to apex; ochreous-whitish; three faintly paler lines beyond middle; discal dot, dots on costa, on costal portions of first and third lines, and on termen

blackish; cilia ochreous-whitish. Hindwings with termen slightly rounded, colour and markings as forewings, but terminal line obsolete and replaced by a row of dark fuscous dots, and costal dots obsolete.

Type in Coll. Lower.

N.Q.: Cooktown (Lower).

60. Pylarge proxima.

Lycauges proxima Butl., Trans. Ent. Soc. 1886, p.435.

♂. 22 mm. Head brownish-ochreous; fillet whitish; face and palpi blackish. Antennæ whitish; ciliations in ♂ 2. Thorax and abdomen whitish, faintly pinkish-tinged, sparsely irrorated with blackish scales, the latter with a blackish dot on the base of each segment. Legs whitish; anterior pair mixed with fuscous. Forewings elongate-triangular, costa gently arched, termen slightly rounded, moderately oblique; pale pinkish-white with sparsely scattered blackish scales; antemedian line obsolete; a fine blackish discal dot; median represented by an oblique pinkish shade from mid-dorsum towards apex; postmedian by a series of blackish dots from near apex to $\frac{2}{3}$ dorsum; subterminal and submarginal lines faintly indicated; a series of minute blackish terminal dots on veins; cilia pinkish-white. Hindwings with termen straight except at apex; 6 and 7 separate; colour and markings as forewings.

Butler's description is not recognisable, but fortunately I have been able to examine his type, which is in the British Museum.

Q.: Rockhampton, Brisbane, in December and April; two specimens—N. S. W.: Sydney.

61. Pylarge loxosema, n.sp.

♂. 17-20 mm. Head fuscous; fillet white; face blackish. Palpi whitish. Antennæ white; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen whitish with a very few scattered blackish scales. Legs whitish; anterior pair mixed with fuscous. Forewings elongate-triangular, costa moderately arched, termen slightly rounded,

strongly oblique; ochreous-whitish, with a very few scattered blackish scales; antemedian line faint or obsolete, oblique; a black discal dot; median following discal dot at some distance, broadly suffused with fuscous, straight, from beneath costa at $\frac{3}{4}$ to dorsum at $\frac{2}{3}$; postmedian fuscous, slender, finely crenulate, from $\frac{7}{8}$ costa to $\frac{5}{6}$ dorsum; subterminal and submarginal pale grey, wavy, parallel; a terminal series of black dots between veins; cilia ochreous-whitish. Hindwings with termen strongly bowed; 6 and 7 connate; colour and markings as forewings, but discal dot on or touching median line.

Type in Coll. Lyell.

Vic.: Lancefield Junction, in March; three specimens received from Mr. G. Lyell; Melbourne (Drake).

62. Pylarge orthoscia.

Acidalia orthoscia Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.861.

Type in Coll. Meyrick.

W.A.: Perth, Geraldton.

63. Pylarge megalocentra.

Acidalia megalocentra Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.862.

Type in Coll. Meyrick.

S.A.: Adelaide.

Gen. 7. Sterrha.

Sterrha Hb., Verz. p.308; Meyr., Trans. Ent. Soc. 1892, p.88.

Face smooth or loosely haired. Palpi rather short, ascending or porrected, shortly rough-scaled beneath or with rough projecting hairs. Antennæ in ♂ filiform or dentate, evenly ciliated or with fascicles, rarely emitted from very short processes. Thorax glabrous or rarely hairy beneath. Femora glabrous or rarely hairy; posterior tibiæ in ♂ moderate, slender, without median spurs, rarely with only one terminal spur; in ♀ without median spurs; posterior tarsi in ♂ moderate. Forewings with 10 out of

11 anastomosing or connected with 9. Hindwings with 6 and stalked (Meyrick).

Type *S. sericeata* Hb.

Having no European types for examination, I cannot be sure at the Australian species are referable to this genus. In them, ein 5 of the hindwings arises from slightly above the middle of e cell, and in *validaria* at least 6 and 7 of hindwings are separate.

Forewings crimson	64. *rhodocosma.*
Forewings not crimson	2.
Forewings with fuscous transverse lines	65. *aglaodesma.*
Forewings green, without fuscous lines	66. *validaria.*

64. Sterrha rhodocosma.

errha rhodocosma Low., Proc. Linn. Soc. N.S. Wales, 1897, p.14.

Type in Coll. Lower.

S.A.: Adelaide.

65. Sterrha aglaodesma.

errha aglaodesma Low., Trans. Roy. Soc. S. Aust. 1893, p.157.

Type in Coll. Lower.

W.A.: Eucla.

66. Sterrha validaria.

Thalassodes validaria Wlk., Brit. Mus. Cat. xxxv. p.1607; *Ephyra lidaria* Hmps., Moths Ind. iii. p.446.

♂♀. 22-24 mm. Head pale yellow or greenish; fillet fuscous; e purple-fuscous. Palpi moderate (1¼); terminal joint minute; rple-fuscous, beneath whitish-ochreous. Antennæ whitish-hreous; in ♂ dentate, dentations terminating in tufts of moder-ely long cilia (1½). Thorax and abdomen pale green. Legs itish-ochreous; anterior and middle femora and anterior coxæ ffused with purplish; posterior tibiæ with one pair of spurs in th sexes; in ♂ with a tuft of hairs on posterior femora near se, and another on posterior tibiæ near apex. Forewings angular, costa nearly straight towards base, towards apex oderately arched, apex round-pointed, termen bowed, oblique; le green; costal edge yellow; a darker linear discal dot, ante-

median, and postmedian lines; a pale finely dentate subterminal line edged with darker green; cilia pale green. Hindwings with termen rounded; colour and markings as forewings. Underside green-whitish.

The structural characters of this species given in the 'Moths of India,' are not quite accurate.

N.Q.: Cairns, Kuranda, Townsville. Also from Celebes; Ceylon, and India.

Gen. 8. SOMATINA.

Somatina Gn., Lep. x. p.10; Hmps., Moths Ind. iii. p.463: *Dithalama* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.840.

Face smooth. Palpi moderate, porrect or subascending. Antennæ in ♂ dentate, ciliated. Posterior tibiæ in ♂ flattened, distorted, without spurs; in ♀ with all spurs present; posterior tarsi in ♂ short. Forewings with vein 10 arising separately, anastomosing with 8 + 9 above 7, and 11 anastomosing with 10, forming a double areole. Hindwings with 3 and 4 separate, 6 and 7 stalked.

Allied to *Leptomeris*, but differing in the structure of vein 10 of forewings.

67. SOMATINA COSMOSPILA.

Dithalama cosmospila Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.840.

Type in Coll. Meyrick.

N.S.W.: Newcastle, Sydney—Vic.: Kewell.

68. SOMATINA RUFIFASCIA.

Somatina rufifascia Warr., Nov. Zool. 1896, p.379.

Though I have seen the types, I have unfortunately seen no other examples of this species, and of the next two. Possibly they represent a variable species.

Type in Coll. Rothschild.

N.Q.: Cooktown.

69. SOMATINA MACULATA.

Somatina maculata Warr., Nov. Zool. 1898, p.244.

Type in Coll. Rothschild.

Q.: Duaringa.

70. Somatina sordida.

natina sordida Warr., Nov Zool. 1898, p.244.
Type in Coll Rothschild
Q.: Duaringa.

Gen. 9. Autanepsia,* nov.

Face smooth. Palpi moderate, not reaching beyond frons, ascending, shortly rough-scaled. Antennæ of ♂ dentate, ated in fascicles. Thorax not hairy beneath. Posterior tibiæ ♂ not dilated, with middle spurs absent, terminal spurs well eloped [♀ unknown]. Forewings with vein 3 from $\frac{4}{5}$, 5 from ntly above middle, 7, 8, 9 stalked, 10 anastomosing first with and then with 8 + 9 to form a double areole. Hindwings with d 7 stalked.

development of *Rhodostrophia* Hb., with which it agrees in ration, but differs in the absence of middle spurs of hind e and non-pectinated antennæ of ♂. The type-species ents the facies of *Eois* or *Leptomeris*.

71. Autanepsia poliodesma,† n.sp.

20 mm. Head dark fuscous; lower $\frac{1}{3}$ of face whitish. Palpi fuscous, anterior surface whitish. Antennæ dark grey. rax pale leaden-grey; collar whitish. Abdomen whitish rated with pale leaden-grey. Legs grey; anterior pair darker; erior pair whitish. Forewings triangular, costa gently ed, apex round-pointed, termen moderately oblique, slightly ed; whitish irrorated with pale leaden-grey, and with pale en-grey transverse lines; antemedian, median, postmedian, subterminal lines all finely wavy and approximately parallel; ansverse linear discal mark before median line, also pale en-grey; a rather broad terminal line of the same colour, with ral slightly darker dots on the extreme margin; cilia grey-

* αὐτανεψιος, a cousin, nearly akin.
† πολιοδεσμος, grey-banded.

whitish. Hindwings with termen rounded; colour and markings as forewings, but antemedian line and discal mark absent.

Type in Coll. Turner.

Q.: Brisbane; in April; one specimen, taken at light.

Gen. 10. PROBLEPSIS.‡

Problepsis Led., Verh. z.-b. Ges. Wien, 1852, Abh. p.74.

Face smooth. Palpi short or moderate, porrected or subascending, with appressed scales or somewhat rough. Antennæ in ♂ shortly bipectinated or rarely dentate, pectinations or teeth ending in fascicles of cilia, towards apex simple. Thorax hairy or almost glabrous beneath. Femora rather hairy or glabrous; posterior tibiæ in ♂ flatly dilated, enclosing a large tuft, without spurs; in ♀ with all spurs present; posterior tarsi in ♂ much abbreviated. Forewings with 10 out of 9, 11 connected or anastomosing with 9. Hindwings with 5 from above middle of cell, 6 and 7 separate.

Type *P. ocellata* Friv., from Europe.

A small Indo-Malayan genus with two European species, closely allied to *Leptomeris*, from which it differs in the ♂ antennæ.

1.	Wings irrorated with fuscous............................	75. *cana.*
	Wings without fuscous irroration	2.
2.	Forewings with a conspicuous dark ocellus..................	3.
	Forewings without ocellus..	72. *clemens.*
3.	Ocellus circular...	73. *apollinaria.*
	Ocellus transversely elongate	74. *sancta.*

72. PROBLEPSIS CLEMENS.

Problepsis clemens Luc., Proc.Linn.Soc.N.S.Wales,1889,p.1093; *Problepsis margaritata* Warr., Nov. Zool. 1896, p.377.

♂ with very long antennal pectinations (8) shortly ciliated on margins and apices.

Type in Coll. Lucas.

Q.: Brisbane.

‡ προβλεψις, conspicuous.

73. Problepsis sancta.

blepsis sancta Meyr., Proc. Linn. Soc. N.S.Wales, 1887,p.839.
ype in Coll. Meyrick.

.Q.: Townsville—Q.: Duaringa, Gayndah, Brisbane, Rose-
d.

74. Problepsis apollinaria.

rgyris apollinaria Gn., Lep. x. p.13; *Problepsis apollinaria*
r., Proc. Linn. Soc. N. S.Wales, 1887, p.838.

.Q.: Cairns, Geraldton, Townsville. Also from Borneo.

75 Problepsis cana.

atina cana Hmps., Moths Ind. iii. p.463.

♀. 26-32 mm. Head white; face fuscous, with a few white s. Palpi $1\frac{1}{4}$; fuscous. Antennæ pale ochreous, towards white; in ♂ shortly laminate ($\frac{1}{2}$), each lamina ending in two l teeth, which bear fascicles of very long cilia (6-7). Thorax abdomen white, with sparse fuscous irroration. Legs white, rior and middle pairs partly suffused with fuscous; posterior of ♂ $\frac{1}{5}$. Forewings triangular, costa straight, strongly ed near apex, apex round-pointed, termen bowed, oblique; e with general sparse fuscous irroration; antemedian line ete; two large roundish ochreous spots placed transversely nd middle, outlined by dark fuscous scales showing metallic e, and connected by a similar line; a fine pale fuscous line ects upper spot with costa and lower with dorsum; a finely ate, outwardly curved, pale fuscous postmedian line, from $\frac{5}{6}$ to $\frac{4}{5}$ dorsum; succeeded by suffused, indistinct, interrupted, erminal and submarginal lines; a black terminal line, ened between veins; cilia white with a few fuscous scales. dwings with termen bowed; colour and markings as fore- s, but discal spot single, narrow, and white-centred.

.Q.: Geraldton, Townsville—N.W.A.: Baudin Island. Also Ceylon and India.

Gen. 11. TRYGODES.

Trygodes Gn., Lep. ix. p.426; Hmps., Moths Ind. iii. p.460: *Antitrygodes* Warr., Nov. Zool. 1895, p.90.

Face smooth. Tongue well-developed. Palpi slender, short, ascending, reaching slightly beyond frons; terminal joint very small. Antennæ of ♂ laminate or shortly pectinate, the laminæ or pectinations ending in tufts of hair on three penultimate segments. Posterior tibiæ of ♂ without spurs. Forewings with 7, 8, 9, 10 stalked, and 11 connected with their common stalk to form a single areolo, or 10 anastomosing first with 11 and then with 9 to form a double areole. Hindwings with 5 from about middle of cell, 6 and 7 separate.

Type, *T. muscivaria* H. Sch., from South America. A small genus found in the tropical regions of both hemispheres. It shows some variability in details of structure. The single areole is found in *T. divisaria*, the peculiar double areole in *T. catacissa*.

Section i. *Posterior tibiæ in ♂ strongly dilated with a tuft of long hairs from inner side of base.*

76. TRYGODES DIVISARIA.

Macaria divisaria Wlk., Brit. Mus. Cat. xxiii. p.927: *Trygodes agrata* F. & R., Reise Nov. pl.128, fig.19: *Trygodes divisaria* Hmps., Moths. Ind. iii. p.460.

♂. 40 mm. Face purple-fuscous, lower edge white; fillet white; crown narrowly dark fuscous. Antennæ fuscous, towards base whitish. Thorax white with a few dull purple scales; anterior edge broadly dull purple. Abdomen white; lateral tufts ochreous-whitish. Legs ochreous-whitish; anterior pair fuscous anteriorly; posterior pair white. Forewings triangular, costa nearly straight, arched towards apex, termen bowed, oblique, wavy; whitish with sparsely scattered dark fuscous scales; costal edge and a subcostal streak suffusedly reddish-violet; several large dark green spots edged with reddish-fuscous in basal half of disc; a small spot in cell near base and a larger between this and dorsum, a large squarish blotch in end of cell, followed by two smaller blotches,

rge blotch before and a smaller beyond origin of vein 2; a wavy fuscous line from $\frac{4}{5}$ costa to tornus; three subapical en and reddish-fuscous spots parallel to termen; a fuscous ninal line; cilia whitish; apices purplish-tinged. Hindwings h termen strongly bowed, sharply dentate; colour like fore-gs, but more strongly violet-tinged; three blotches like fore-gs, two median within and beyond cell, and a third between e and inner margin; some ferruginous suffusion beyond ches; wavy purplish postmedian and subterminal lines, the er with a sharp median projection; terminal line and cilia as wings.

large and very handsome species. The green blotches on gs are somewhat variable.

ype in British Museum.

.Q.: Kuranda and Geraldton (Johnstone River); two speci-s Also from Celebes, Ceylon, and India.

Section ii. *Posterior tibiæ of ♂ slender, without tuft.*

77. TRYGODES CATACISSA,* n.sp.

. 28 mm. Head pale ochreous; fillet reddish-fuscous; face ish-fuscous, lower edge whitish. Palpi whitish, outer surface ish-fuscous. Antennæ whitish-ochreous, towards base ish-fuscous; in ♂ with short ($\frac{2}{3}$) slender pectinations ending scicles of long cilia ($2\frac{1}{2}$). Thorax and abdomen grey-whitish a very few scattered blackish scales. Legs ochreous-whitish; rior tibiæ and tarsi pale fuscous anteriorly; posterior tibiæ slender, without spurs. Forewings triangular, costa gently ed, apex round-pointed, termen bowed, oblique; grey-whitish a very few scattered blackish scales; costal edge pale reddish; een subapical spot beneath $\frac{1}{6}$ costa, edged with fuscous, owly connected with a similar elongate fascia-like spot which hes to dorsum at $\frac{3}{4}$; the latter is constricted near middle and outwards towards dorsum; several lines of fine fuscous

* κατακισσος, ivy-wreathed.

strigulæ between this and termen; a grey terminal line; cilia white. Hindwings with termen bowed; groundcolour as forewings; a row of five unequal roundish green spots from ¾ dorsum transversely towards costa, but not reaching half-way, outlined with fuscous, and preceded by a fuscous line; cilia white with basal fuscous dots opposite veins. Underside whitish.

Type in Coll. Turner.

N.Q.: Kuranda, in October and November; two specimens, of which one is in Coll. Lyell.

Gen. 12. CHRYSOCRASPEDA.

Chrysocraspeda Hmps., Moths Ind. iii. p.443.

Face smooth. Tongue well-developed. Palpi short, slender, porrect; terminal joint minute. Antennæ of ♂ with a double row of long pectinations, apical ¼ simple. Posterior tibiæ with all spurs present in both sexes. Forewings with no areole, 7, 8, 9, 10, 11 stalked. Hindwings with 3 and 4 stalked, 5 from middle or slightly above middle of cell, 6 and 7 stalked.

An Indo-Malayan genus of some extent, easily recognised by the absence of the areole, and by the crimson and yellow coloration of the species. According to Hampson, the stalking of 3 and 4, and of 6 and 7 of the hindwings is not constant.

Type *C. abhadraca* Wlk., from Ceylon and India.

1.	Forewings with a broad yellow fascia from beneath costa to tornus	78. *inundata*.
	Forewings without yellow fascia	2.
2.	Hindwings with discal spot white	79. *aurimargo*.
	Hindwings with discal spot yellow	80 *cruoraria*.

78. CHRYSOCRASPEDA INUNDATA.

Chrysocraspeda inundata Warr., Nov. Zool. 1898, p.238.

♀. 22 mm. Head, palpi, thorax, and abdomen dull crimson. Antennæ whitish, towards base crimson-tinged. [Legs broken]. Forewings oval, costa strongly arched, apex rounded, termen long, obliquely rounded; dull crimson; a broad sharply defined yellow bar commencing abruptly at subcostal vein before middle,

curved outwards and gradually dilated to end on tornus; upper half of termen narrowly yellow; cilia yellow. Hindwings elongate-oval, termen very strongly bowed; dull crimson; a white discal dot at $\frac{1}{3}$; termen narrowly yellow; cilia yellow.

Type in Coll. Rothschild.

N.Q.: Kuranda, in October; one specimen in Coll. Lyell, received from Mr. F. P. Dodd. Also from New Guinea.

79. Chrysocraspeda aurimargo.

Chrysocraspeda aurimargo Warr., Nov. Zool. 1897, p.216.

♂. 21-22 mm. Head, face, palpi, and antennæ dull crimson; antennal pectinations in ♂ very long (10). Thorax and abdomen ochreous-crimson. Legs pale ochreous; anterior and middle pairs crimson-tinged. Forewings triangular, costa slightly arched, apex round-pointed, termen bowed, oblique; ochreous-crimson with fine fuscous strigulations; a median fuscous discal dot, a fuscous postmedian line from $\frac{2}{3}$ costa bent outwards and then inwards to $\frac{2}{3}$ dorsum; a fine yellow terminal line, mixed with crimson, from apex to beyond middle; a yellow spot on tornus narrowly prolonged on termen; cilia yellow. Hindwings oblong, termen obtusely angled; colour and markings as forewings, but discal dot white margined with fuscous. Underside dull crimson with yellow markings as above.

Type in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in May and June; two specimens (F. P. Dodd).

80. Chrysocraspeda cruoraria.

Chrysolene cruoraria Warr., Nov. Zool. 1897, p.49.

♀. 24 mm. Head fuscous; face, palpi, and antennæ crimson. Thorax fuscous with a posterior crimson spot. [Abdomen broken]. Legs pale ochreous; anterior and middle pairs suffused with crimson. Forewings elongate-triangular, costa moderately arched, apex round-pointed, termen long, strongly bowed, strongly oblique; deep crimson; a fuscous suffusion at base prolonged along costa to $\frac{1}{4}$, and more broadly along dorsum nearly to tornus;

a suffused yellow central spot; a subapical fuscous suffusion from costa to vein 3; termen suffused with yellow; cilia yellow, interrupted by a crimson bar at mid-termen. Hindwings oblong, termen strongly produced to form an obtuse angle; deep crimson; a suffused yellow spot at $\frac{1}{3}$; a broad fuscous postmedian band; termen and cilia as forewings. Underside similar without fuscous suffusions and less vivid.

This beautiful species is a true *Chrysocraspeda*, having 7, 8, 9, 10, 11 of forewings stalked.

Type in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in July; one specimen (F. P. Dodd).

Gen. 13. Ptochophyle.

Ptochophyle Warr., Nov. Zool. 1896, p.293.

Face smooth. Tongue well developed. Palpi short, slender, ascending; terminal joint minute. Antennæ in ♂ with a double row of long pectinations, apical $\frac{1}{4}$ simple. Posterior tibiæ with all spurs present in both sexes. Forewings with 7, 8, 9, 10 stalked, 11 anastomosing very shortly with their common stalk well before origin of 7. Hindwings with 5 from slightly above middle of cell, 6 and 7 stalked.

This genus is not to be confused with the European *Leucophthalmia* Hb., (*Ephyra* Dup.), which is more closely allied to *Gnamptoloma* by the neuration. I cannot be quite sure that the genus here described is that to which Mr. Warren gave the name *Ptochophyle*, but it appears probable.

Type *P. notata* Warr., from the Louisiades.

81. Ptochophyle cyphosticha,* n.sp.

♂♀. 20-24 mm. Head, palpi, and antennæ pale reddish-brown; pectinations in ♂ very long (10). Thorax and abdomen pale reddish-brown; sides of abdomen ochreous-whitish. Legs whitish-ochreous; anterior and middle pairs with some pale crimson

* κυφοστιχος, with bent line.

suffusion. Forewings triangular, costa nearly straight except close to base and apex, apex rounded-rectangular, termen moderately oblique, strongly bowed and prominent on veins 3 and 4, crenulate; ochreous-brown finely strigulated with darker brown; lines brown; a slender antemedian line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a minute white median discal dot; a slender postmedian line from $\frac{2}{3}$ costa towards tornus, bent sharply inwards in mid-disc, and then curved outwards to $\frac{3}{4}$ dorsum; a terminal series of minute fuscous dots between veins; cilia pale brown. Hindwings with termen rounded, crenulate; as forewings, but antemedian line obsolete, and postmedian line angled in middle. Underside pale ochreous with suffused subterminal and terminal pale crimson fasciæ, more or less developed.

Type in Coll. Turner.

N.Q.: Cairns, Kuranda, in December; Townsville; three specimens.

Gen. 14. GNAMPTOLOMA.

Gnamptoloma Warr., Nov. Zool. 1895, p.95.

Face smooth. Tongue well developed. Palpi moderate, ascending, terminal joint short. Antennæ of ♂ with a double row of pectinations, apical $\frac{1}{3}$ simple. Posterior tibiæ with two pairs of spurs in both sexes; posterior femora and sometimes also tibiæ in ♂ with long tufts of hairs. Forewings with apex acute; 7, 8, 9, 10 stalked, areole single, 11 anastomosing with 8+9 beyond 7. Hindwings with termen angled; 3 and 4 stalked, 5 from somewhat above middle of cell, 6 and 7 stalked.

I regard the long-stalking of vein 11 as the most important characteristic of this genus. The same occurs in the European genus *Ephyra* Dup. = *Leucophthalmia* Hb. *Calothysanis* Hb. = *Timandra* Dup., to which Mr. Meyrick and Sir Geo. Hampson refer the species, differs essentially in vein 11 not anastomosing, but connected by a short bar with 8 + 9 opposite 7; at least this is so in specimens of *C. amata* which I have examined.

Type *G. aventiaria*.

Forewings with termen angulated.................................... *aventiaria*.
Forewings with termen showing a rounded prominence only... *mundissima*.

82. Gnamptoloma aventiaria.

Timandra aventiaria Gn., Lep. x. p.3; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.864.

The colour of the wings varies from green to greenish-ochreous and dull reddish.

N.Q.: Cairns, Townsville—Q.: Duaringa, Brisbane. Also from Java, Formosa, Ceylon, and India.

83. Gnamptoloma mundissima.

Acidalia (?) *mundissima* Wlk., Brit. Mus. Cat. xxiii. p.795: *Timandra prasodes* Meyr., Proc.Linn.Soc.N.S.Wales,1887,p.865: *Timandra mundissima* Hmps., Moths Ind. iii. p.460: ? *Timandra malacopis* Low., Trans. Roy. Soc. S. Aust. 1902, p.228.

Probably a variable species. I have only a solitary example in poor condition, and am indebted to Sir Geo. Hampson for its identification.

Q.: Duaringa, Bundaberg. Also from Ceylon, India, and Africa.

Gen. 15. Organopoda.

Organopoda Hmps., Ill. Het. ix. p.147 (1893); Moths Ind. iii. p.451.

Frons smooth. Tongue developed. Palpi porrect, elongate; second joint projecting well beyond frons; terminal joint elongate. Antennæ of ♂ serrate with fascicles of cilia. Hind tibiæ and tarsi of ♂ much aborted and distorted. Forewings with 7, 8, 9, 10 stalked, 10 anastomosing first with 11 then with 8 + 9 opposite 7 to form a double areole. Hindwings with 3 and 4 separate, 5 from middle of cell, 6 and 7 short-stalked.

Type *O. carnearia* Wlk., from Ceylon.

A small Indo-Malayan genus. I have no male for examination, and must refer the reader to the 'Moths of India' for a full description of the much modified posterior male tibiæ and tarsi in the type. Probably these structures vary in the different species.

84. Organopoda olivescens.

Organopoda olivescens Warr., Nov. Zool. 1896, p.374.

♀. 28 mm. Head brown-whitish; fillet white; face purple-reddish. Palpi $1\frac{1}{4}$; terminal joint $\frac{1}{3}$ second; purple-reddish, beneath whitish. Antennæ towards base white, towards apex grey. Thorax and abdomen brownish-grey. Legs whitish-ochreous; anterior pair dull purple. Forewings triangular, costa rather strongly arched towards apex, apex round-pointed, termen bowed, oblique; brownish-grey; traces of a fuscous, transverse line at $\frac{1}{3}$; a conspicuous dark fuscous median discal dot; a slender, finely dentate, fuscous line from $\frac{3}{4}$ costa to $\frac{3}{4}$ termen; cilia brownish-grey. Hindwings with termen rounded; colour and markings as forewings.

Type in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in October; one specimen (F. P. Dodd).

Gen. 16. Brachycola.

Brachycola Warr., Nov. Zool. 1897, p.48.

Face smooth. Tongue well developed. Palpi porrect, elongate; second joint far exceeding frons; terminal joint elongate. Antennæ in ♂ with a double row of long pectinations, apical $\frac{1}{3}$ simple. Posterior tibiæ of ♂ extremely short, densely clothed with long hairs beneath, usually with three long terminal spurs; first tarsal joint immensely elongate; posterior tibiæ of ♀ normal, with all spurs present. Forewings with 7, 8, 9, 10 stalked, 11 anastomosing with 8+9 beyond 7 forming a narrow areole. Hindwings with 3 and 4 separate, connate, or short-stalked, 5 from middle of cell, 6 and 7 separate, connate, or short-stalked.

This and the following genera form a large group of species characteristic of the Indo-Malayan region. The structure of the female corresponds to the above definition throughout, except that the areole may be absent, 11 arising from 8+9 beyond 7. But the male sex shows much variability of structure. The most trustworthy characters for generic division are found in the structure of the posterior legs of the male. The genus *Mesotrophe*

Hmps., founded on the hairiness of the middle tibiæ of the male, cannot be maintained, as the posterior legs of the species showing this character correspond to those of different groups of species with smooth middle tibiæ.

The type of *Brachycola* is *absconditaria* Wlk., from Ceylon and India.

1. Fore- and hindwings with large circular discal blotches	86. *cyclophora*
Wings without circular blotches	2.
2. Wings yellow	85. *glycydora.*
Wings not yellow	2.
3. Wings grey-whitish, discal dots of forewings minute or obsolete	87. *obrinaria.*
Wings ochreous-whitish, discal dot of forewings conspicuous	88. *porphyropis.*

Section i. *Middle tibiæ and tarsi of ♂ clothed with long hairs.*

85. Brachycola glycydora,* n.sp.

♂♀. 27-32 mm. Head yellow, with a few reddish scales; face whitish-ochreous, upper edge fuscous. Palpi $2\frac{1}{2}$; purple-reddish, beneath whitish-ochreous. Antennæ pale yellowish irrorated with fuscous and reddish, towards apex grey; pectinations in ♂ very long (10). Thorax and abdomen yellow with a few reddish scales; abdomen with a pair of basal and one or two median fuscous dots, sides and apex whitish. Legs whitish-ochreous suffused, especially anterior pair, with purple. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; yellow minutely dotted with reddish; three small dark fuscous spots on costa at $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, and three minute fuscous dots between the last and apex; several dark fuscous spots in basal part of disc; lines pale grey, suffused, containing dark fuscous dots on veins; antemedian at $\frac{1}{5}$, ill-defined; median and postmedian parallel, arising from costal spots, first outwardly oblique, and then bent inwards beneath costa towards dorsum; subterminal and terminal series of dark fuscous dots between

* γλυκυς, sweet; δωρον, a gift.

veins; cilia yellow with minute basal reddish dots opposite veins. Hindwings with termen rounded, slightly toothed in middle; colour and markings as forewings, with a rather large annular dark fuscous yellow-centred spot in disc at $\frac{1}{3}$. Under side pale yellowish; suffused and spotted with purplish; with a terminal series of dark fuscous spots.

Type in Coll. Turner.

N.Q.: Kuranda, in March and May; two specimens (F. P. Dodd).

86. Brachycola cyclophora,* n sp.

♀. 26-30 mm. Head, thorax, and abdomen pale ochreous with scattered dark fuscous scales. Palpi very long and slender ($3\frac{1}{2}$), terminal joint half second; above purple-fuscous, beneath whitish. Antennæ whitish. Legs whitish-ochreous, anterior and middle pairs suffused with dull purple. Forewings triangular, costa gently arched near base and apex, apex rounded, termen bowed, oblique; pale ochreous speckled with dark fuscous; fuscous bars from $\frac{1}{6}$ and $\frac{3}{5}$ costa representing antemedian and median lines; a large circular spot in mid-disc, grey-whitish outlined with dark fuscous; a short fuscous line from $\frac{5}{6}$ costa continued by a series of dark fuscous dots on veins to $\frac{4}{5}$ dorsum; a terminal series of dark fuscous dots between veins; cilia pale ochreous, with a basal series of fuscous dots opposite veins. Hindwings with termen rounded, dentate; colour and markings as forewings. Underside whitish-ochreous strigulated and suffused with dull purple.

Placed here conjecturally in the absence of the male.

Type in Coll. Turner.

N.Q.: Kuranda, in March and April; three specimens (F. P. Dodd).

Section ii. *Middle tibiæ of ♂ smooth-scaled.*

87. Brachycola obrinaria.

Ephyra obrinaria Gn., Lep. ix. p.414; *Anisodes obliviaria* Wlk., Brit. Mus. Cat. xxii. p.643; *Acidalia contrariata* Wlk., *op. cit.*

* κυκλοφορος, bearing rings or circles.

xxiii. p.770; *Anisodes similaria* Wlk., *op. cit.* xxvi. p.1582; *Anisodes caligata* Wlk., *op. cit.* xxvi. p.1584; *Anisodes suspicaria* Snel., Tijd. v. Ent. xxiv. p.80, pl. viii., f.6; *Anisodes obrinaria* Hmps., Moths Ind. iii. p.446.

♂♀. 32-38 mm. Head grey-whitish; face brownish-fuscous, lower half whitish. Palpi, ♂ 2, ♀ 2½; purple, beneath whitish. Antennæ grey-whitish; pectinations in ♂ very long (12). Thorax and abdomen grey-whitish. Legs whitish; anterior pair suffused with purple; tuft on posterior tibiæ of ♂ purple, partly concealing three long terminal spurs. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; grey-whitish, with scattered scales of obscure fuscous, a fuscous dot beneath ¼ costa, a second on median vein below this, and a third above ¼ dorsum; discal dot minute or obsolete; an obscure median shade from ⅔ costa to mid-dorsum; a series of minute fuscous dots on veins at ⅚; terminal fuscous dots indistinct; cilia grey-whitish. Hindwings with termen rounded, rather prominent and angled at tornus; colour and markings as forewings; discal dot white-centered, usually minute, sometimes conspicuous. Underside whitish with fuscous postmedian and terminal series of dots.

N.Q.: Townsville, in February; three specimens (F. P. Dodd)—Q.: Brisbane, in March and May; two specimens. Also from Malay Archipelago, Ceylon, and India.

88. Brachycola porphyropis.

Perixera porphyropis Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.837.

Variable in the extent of the development of the dark markings on wings. The square fuscous suffusion at tornus of hindwings is only occasionally developed. Antennal pectinations in ♂ very long (12). Tuft on tibiæ of ♂ purple, partly concealing one very stout and long terminal spur. Veins 3 and 4, and also 6 and 7, of hindwings sometimes separate.

Type in Coll Meyrick.

Q.: Brisbane, Stradbroke Island, Mount Tambourine—N.S.W.: Newcastle, Sydney.

Gen. 17. Perixera.

Perixera Meyr., Trans. Ent. Soc. 1886, p. 209.

Palpi elongate; terminal joint elongate. Forewings sometimes without areole. Posterior femora of ♂ with a dense tuft of hairs; posterior tibiæ of ♂ without middle spurs.

Type *P. prionodes* Meyr., from Fiji. Mr. Meyrick described two species under this genus, which is defined by characters drawn from the ♂. As the first species was represented only by a ♀ type, the second must be taken to be the type of the genus. Subsequently Mr. Meyrick ascribed *porphyropis* Meyr., to the same genus, but he had only ♀ examples before him.

1. Wings brownish, discal spot of hindwings large, snow-white .... 89. *monetaria*.
   Wings not brownish, hindwings without white spot ..... 2.
2. Wings without median line.. 90. *lophosceles*.
   Wings with median line well developed...................... 91. *odontota*.

89. Perixera monetaria.

Anisodes monetaria Gn., Lep. ix. p. 418, *nec* Hmps., Moths Ind. iii. p. 450; *Perixera* (?) *pleniluna* Warr., Nov. Zool. 1897, p. 394; *Perixera leucopelta* Low., Proc. Linn. Soc. N. S. Wales, 1898, p. 42.

♂. 38 mm. Head pale reddish-brown; fillet white; upper part of face reddish-purple. Palpi 2½, reddish-purple, beneath whitish-ochreous. Antennæ white, towards apex grey; pectinations in ♂ very long (12). Thorax and abdomen pale reddish-brown. Legs whitish-ochreous; anterior pair with some purplish suffusion; tuft on posterior femora of ♂ whitish-ochreous. Forewings triangular, costa scarcely arched, except near base and apex, apex round-pointed, termen bowed, oblique; 11 stalked, no areole; pale reddish-brown; a faint fuscous line from ¾ costa to ¾ dorsum; cilia pale reddish-brown. Hindwings with termen rounded, slightly crenulate, forming a prominent angle at tornus; colour and postmedian line as forewings; a large circular snow-white discal spot, outlined with fuscous. Underside paler without postmedian lines.

N.Q.: Townsville, in February; one specimen (Mr. F. P. Dodd). Also from Borneo and the Malay Peninsula.

90. Perixera lophoscelES,* n.sp.

♂. 32 mm. Head and thorax whitish-grey; face brownish-fuscous. Palpi $1\frac{3}{4}$; purple, beneath whitish. Antennæ whitish-grey, pectinations of ♂ long (8). Antennæ whitish-grey, sides tinged with purple. Legs ochreous-whitish; anterior pair suffused with purple; tuft on ♂ femora purple. Forewings triangular, costa gently arched, apex round-pointed, termen bowed, oblique, crenulate; whitish-grey; a dark fuscous dot beneath $\frac{1}{5}$ costa, a second on median vein beneath this, a third above and a fourth on $\frac{1}{5}$ dorsum; discal dot pale-centred, outlined with pale fuscous; a conspicuous series of dark fuscous dots on veins at $\frac{4}{5}$; a similar terminal series between veins; cilia grey-whitish with minute basal fuscous dots between veins. Hindwings with termen rounded, dentate; colour and markings as forewings. Underside purple-whitish with fine fuscous postmedian line at $\frac{4}{5}$.

Type in Coll. Turner.

N.Q.: Townsville, in February; one specimen (Mr. F. P. Dodd).

91. Perixera odontota,† n.sp.

♂. 30 mm. Head whitish; fillet white, bordered posteriorly by a fine blackish line; face above greenish-fuscous, beneath whitish. Palpi 2; purple, internal surface ochreous-whitish. Antennæ white with fine blackish irroration; pectinations in ♂ very long (10). Thorax and abdomen grey-whitish with a few dark fuscous scales. Legs ochreous-whitish partly suffused with purple; anterior pair purple; tuft on posterior femora of ♂ purple. Forewings elongate-triangular, costa scarcely arched except near base and apex, apex rounded, termen obliquely rounded, dentate, grey-whitish finely irrorated with fuscous;

* λοφοσκελης, with tufted legs.

† ὀδοντοτος, toothed.

lines pale fuscous, rather strongly oblique; antemedian at $\frac{1}{5}$, indistinct; a minute dark fuscous discal dot; median from $\frac{2}{3}$ costa to before mid-dorsum, finely dentate above, broader and suffused below; postmedian represented by a series of dark fuscous dots on veins at $\frac{4}{5}$; succeeded by broad, indistinct subterminal and submarginal lines; a terminal series of blackish dots between veins; cilia grey-whitish with minute blackish dots opposite veins. Hindwings with termen slightly rounded, strongly and acutely dentate; colour and markings as forewings but discal dot and postmedian line better marked. Underside of forewings dull purple with faintly darker discal dot and postmedian line, and broad whitish terminal line which is partly double. Hindwings whitish with purple median, postmedian, subterminal, and submarginal lines.

In shape of wings and coloration of upper side this closely resembles a species of the genus *Selidosema*, but the underside is very different.

Type in Coll. Turner.

N.Q.: Kuranda, in April; one specimen (Mr. F. P. Dodd).

Gen. 18. ANISODES.

Anisodes, Gn., Lep. ix. p.415; Hmps., Moths Ind. iii. p.446; *Stibarostoma*, Warr., Nov. Zool. 1896, p.380.

Palpi elongate; terminal joint always elongate in ♀, in ♂ often abbreviated; second joint in ♂ often crested with long scales above and beneath. Posterior femora of ♂ without tuft; posterior tibiæ of ♂ without middle spurs. Forewings often without areole.

The structure of the ♂ palpi exhibits very considerable variations in this genus, but these differ in closely allied species and are not available for generic definition.

1. Wings whitish	2.
Wings not whitish	4.
2. Wings suffused, dots obsolete	92. *griseata*.
Wings with conspicuous dots, at least in postmedian line	3.

3. Palpi of ♂ with a brush of long hairs on lower surface of second joint, upper surface smooth.............. 93. *pallida*.
   Palpi of ♂ without brush on lower surface of second joint, upper surface with loose spreading hairs 94. *leptopasta*.
4. Wings pale yellowish.. 96. *pulverulenta*.
   Wings mostly chocolate-brown........................... 95. *sciota*.

Section i. *Palpi of ♂ with terminal joint more or less abbreviated* (Stibarostoma). *Forewings without areole.*

92. Anisodes griseata.

Stibarostoma griseata Warr., Nov. Zool. 1896, p.380; *Perixera* (?) *longidiscata* Warr., Nov. Zool. 1904, p. 487; *Stibarostoma pulverata* Warr., Nov. Zool. 1905, p. 424.

♂♀. 28-31 mm. Head ochreous-whitish; face in ♂ whitish-ochreous, in ♀ purple except lower edge, which is whitish-ochreous. Palpi purple above, whitish-ochreous beneath; in ♂ 3½, second joint very elongate, sigmoid, with a strong tuft of whitish-ochreous hairs from upper surface near apex, directed backwards, terminal joint very short; in ♀ 3½, terminal joint normal. Antennæ ochreous-whitish; pectinations in ♂ very long (10). Thorax and abdomen ochreous-whitish, the latter with some purple suffusion on sides. Legs whitish-ochreous; anterior pair suffused with purple. Forewings triangular, costa gently arched, apex rounded, termen slightly bowed, oblique; ochreous-whitish finely irrorated with grey-whitish; a transverse linear discal mark at end of cell, best seen in ♀; a terminal series of minute fuscous dots; cilia ochreous-whitish. Hindwings with termen rounded, slightly crenulate; as forewings, but discal mark pale and indistinct.

The ♂ is readily recognised by the peculiar palpi; the ♀ may be known by the suffused wings without markings, except the linear discal mark.

Type in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in June, two specimens bred by Mr. F. P. Dodd from *Ficus glomerata*; Townsville, in February, two specimens.

93. ANISODES PALLIDA.

Anisodes pallida Moore, Lep. Ceyl. iii. p. 445, Pl. 201, f. 11; *rixera syntona* Meyr., Trans. Ent. Soc. 1889, p. 487.

♂♀. 27-30 mm. Head and thorax ochreous-whitish with a w dark fuscous scales. Palpi purple above, whitish beneath; ♂ 1½, second joint smooth above, beneath with long hairs ected somewhat backwards, terminal joint minute, bent downrds; in ♀ 2½, terminal joint elongate. Antennæ ochreousitish; pectinations in ♂ 8. Abdomen ochreous-whitish; les suffused with purple; a dorsal series of dark fuscous dots gs ochreous-whitish; anterior and middle veins suffused with rple. Forewings triangular, costa gently arched, apex tolerably inted, termen bowed, oblique; ochreous-whitish with scattered rk fuscous scales and blackish dots; a dot beneath costa near se, and another above dorsum near base; three or four dots out cell; a median discal dot; a series of dots from $\frac{4}{5}$ costa to lorsum, the fourth dot displaced inwards; a terminal series of ts; cilia ochreous-whitish with a basal series of minute dots. ndwings with termen rounded; as forewings but discal spot ger, subtriangular, ochreous-whitish outlined with blackish. derside whitish with some purplish suffusion, and postmedian l terminal series of purple dots.

There has been some confusion over Moore's species. I follow Geo. Hampson's identification. The species should be dily recognised by the peculiar ♂ palpi.

N.Q.: Kuranda, from March to August.—Q.: Burpengary ar Brisbane, in April, attached to *Phyllanthus Ferdinandi*. so from New Guinea and Ceylon.

94. ANISODES LEPTOPASTA,*n.sp.

♂♀. Head and thorax ochreous-whitish; upper edge of face rrowly purple. Palpi purple above; ochreous-whitish beneath; ♂ 2, second joint moderate, rough-haired above, smooth

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*λεπτοπαστος, lightly sprinkled.

beneath, terminal joint $\frac{2}{3}$ second; in ♀ 3, second and terminal joints elongate, smooth. Antennæ ochreous-whitish; pectinations in ♂ 8. Abdomen ochreous-whitish, sides suffused with purple, sometimes with median dorsal dark fuscous dots. Legs ochreous-whitish; anterior pair purple. Forewings rather elongate-triangular, costa gently arched, apex tolerably pointed, termen bowed, oblique; ochreous-whitish finely irrorated with purple-fuscous; a few blackish scales along costa; discal dot obsolete; a faint grey median shade from $\frac{2}{3}$ costa to mid-dorsum; a series of blackish dots on veins at $\frac{4}{5}$, and another between veins on termen; cilia ochreous-whitish, with minute basal blackish dots opposite veins. Hindwings with termen rounded, slightly dentate; as forewings but discal dot conspicuous, blackish, sometimes with whitish centre, rarely obsolete. Underside whitish; forewings with purple suffusion; postmedian and subterminal purple lines, extending only to costa of hindwings; a series of purple terminal dots.

Type in Coll. Turner.

N.Q.: Cairns, one specimen; Kuranda, in October, December, and May; four specimens (F. P. Dodd).

Section ii. *Palpi of ♂ with terminal joint not abbreviated. Middle tibiæ of ♂ densely hairy.*

95. Anisodes sciota,*n.sp.

♂. 42 mm. Head purple-fuscous; between antennæ whitish. Palpi $1\frac{1}{2}$; purple-fuscous, lower surface and apex whitish-ochreous. Antennæ purple-fuscous; dentations in ♂ very long (12). Thorax and abdomen purple-grey. Legs whitish with pale purple suffusion; middle tibiæ and first tarsal joints of ♂ elongate and densely clothed beneath with long pale ochreous hairs. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; whitish-ochreous strigulated and blotched with ochreous-brown; costa with a broad suffused purple-fuscous streak to $\frac{4}{5}$; basal area

* σκιοτος, shaded.

ostly ochreous-brown; a minute white discal dot before middle; suffused median ochreous-brown fascia, bifurcating below and nnected with an irregular blotch of the same colour on tornus d lower part of termen; a smaller irregular ochreous-brown otch on termen beneath apex; cilia brownish. Hindwings th termen rounded; colour as forewings, but mostly ochreous-own, the whitish-ochreous confined to a large apical area. nderside pale purplish; costa of forewings strigulated with cous.

Type in Coll. Turner.

N.Q.: Kuranda, in February; one specimen (F. P. Dodd).

Section iii. *Palpi of ♂ with terminal joint not abbreviated. ddle tibiæ of ♂ smooth.*

96 Anisodes pulverulenta.

Anisodes pulverulenta Swin., Trans. Ent. Soc. 1892, p.9, pl.i. f.8; nps., Moths Ind. iii. p.448.

♂. 29 mm. Head whitish-ochreous; some fuscous scales on per edge of face. Palpi 3½; terminal joint in ♂ elongate, ⅔ of ond; purple above, whitish-ochreous beneath. Antennæ itish-ochreous with a few fuscous scales; pectinations in ♂ 10. orax and abdomen whitish-ochreous with a few fuscous-brown les. Legs whitish-ochreous; anterior pair with some purplish fusion. Forewings triangular, costa gently arched, apex unded, termen bowed, oblique, slightly crenulate; whitish-reous with numerous fuscous-brown specks, which become rk fuscous near costa; a broad suffused pale brownish bar from neath ¼ costa to tornus, connected by a broad process with d-costa; a terminal series of blackish dots between veins; cilia itish-ochreous with basal fuscous-brown scales opposite veins. indwings with termen rounded, dentate; colour as forewings; small fuscous discal dot. Underside whitish with some faint rple strigulation and dark fuscous terminal spots.

N.Q.: Townsville, in February; one specimen (Mr. F. P. Dodd). lso from India.

Gen. 19. PISORACA.

Pisoraca Wlk., Brit. Mus. Cat. xxiv. p.1078; *Trirachopoda* Hmps., Ill. Het. ix. p.148.

Palpi elongate; terminal joint more or less elongate, similar in both sexes. Posterior tibiæ of ♂ with a single median spur. Forewings with areole sometimes absent.

Type *P. bitactata* Wlk., from South Africa.

1.	Wings yellowish	97. *nephelospila.*
	Wings brown	98. *niveopuncta.*
	Wings whitish	2.
2.	Forewings with postmedian line strongly angled inwards beneath costa	99. *punctata.*
	Forewings with postmedian line not strongly angled inwards	3.
3.	Face purple-fuscous above, whitish beneath	100. *cryptorhodata.*
	Face brownish	101. *decretaria.*

Section i. *Middle tibiæ of ♂ densely hairy.*

97. PISORACA NEPHELOSPILA.

Perixera nephelospila Meyr., Trans. Ent. Soc. 1889, p.487.

Male with long antennal pectinations (12); anterior and middle femora hairy on posterior surface; middle femora densely clothed with long hairs on posterior surface. Palpi in both sexes $1\frac{3}{4}$, terminal joint $\frac{2}{3}$.

Somewhat variable but easily recognised by the structural characters of the male, yellow-ochreous coloration, large size (36-40 mm.); and white discal dot of hindwings without dark edge.

Type in Coll. Meyrick.

N.Q.: Kuranda, in August, February, and March; four specimens (Mr. F. P. Dodd). Also from New Guinea.

Section ii. *Middle tibiæ of ♂ smooth.*

98. PISORACA NIVEOPUNCTA.

Brachycola niveopuncta Warr., Nov. Zool. 1897, p.48; *Perixera transversata* Warr., Nov. Zool. 1897, p.58.

♂♀. 24-26 mm. Head pale reddish; face purple. Palpi $1\frac{1}{4}$ in oth sexes, terminal joint rather short ($\frac{1}{3}$ second); purple, beneath hitish. Antennæ whitish; pectinations in ♂ 8. Thorax pale ddish. Abdomen pale reddish, sides whitish-ochreous. Legs hreous-whitish, anterior pair suffused with purple. Forewings angular, costa moderately arched, apex rounded, termen wed, oblique; pale reddish with fine sparse fuscous irroration; scal dot and antemedian line obsolete; postmedian line pale scous or obsolete; a series of fuscous dots on veins at $\frac{5}{6}$; a minal series of fuscous dots between veins; cilia pale reddish. ndwings with termen rounded; colour and markings as fore- ngs; a minute white discal dot, occasionally margined with cous. Under side of forewings pale purplish, of hindwings itish, purplish towards costa and termen.

Ab. *transversata*. Both wings with conspicuous dark fuscous s accentuating and supplementing the usual markings.

This species corresponds to Mr. Warren's female type. The le type is, I think, an example of *Brachycola porphyropis*. pe in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in October, January, February, y, June, July, and August; a series received from Mr. F. P. dd.

99. Pisoraca punctata.

soraca punctata Warr., Nov. Zool. 1897, p.222.

♂♀. 24-26 mm. Head and face ochreous-whitish. Palpi in $1\frac{3}{4}$, in ♀ $2\frac{1}{2}$; purple above, ochreous-whitish beneath. Antennæ itish; pectinations in ♂ 10. Thorax ochreous-whitish with a r of fuscous dots on posterior edge. Abdomen ochreous- itish with a dark fuscous spot on dorsum of third segment. gs whitish; anterior pair suffused with purple. Forewings angular, costa arched at extremities, apex round-pointed, men bowed, oblique; ochreous-whitish, with a few scattered cous scales; a fuscous dot at base, and three dots representing basal line at $\frac{1}{5}$; a median discal dot; a fine pale fuscous dentate e from $\frac{2}{3}$ costa to mid-dorsum; a very fine acutely dentate line

at $\frac{5}{6}$ with fuscous dots on dentations; this line is acutely angled inwards at $\frac{1}{3}$ from costa, and at apex of angle is a conspicuous fuscous spot; a terminal series of blackish dots between veins; cilia whitish with some basal purple-fuscous scales opposite veins. Hindwings with termen rounded, wavy, almost dentate; colour and markings as forewings. Underside whitish, forewings with some purplish suffusion, and discal, subterminal, and terminal dots purple.

Type in Coll. Rothschild.

N.Q.: Cooktown, Kuranda, in October; three specimens received from Mr. F. P. Dodd.

100. PISORACA CRYPTORHODATA.

Aspilates (?) *cryptorhodata* Wlk., Brit. Mus. Cat. xxvi. p. 1682.

♂♀. 28-32 mm. Head whitish; face dull purple, lower third whitish. Palpi in ♂ 2, in ♀ 3; whitish, upper surface suffused with dull purple. Antennæ whitish; pectinations in ♂ 10. Thorax ochreous-whitish. Abdomen ochreous-whitish with a few fuscous scales sometimes forming indistinct median fuscous dots. Legs whitish; anterior pair suffused with dull purple. Forewings triangular, costa nearly straight, apex round-pointed, termen only slightly bowed, slightly oblique; ochreous-whitish, rarely slightly brownish-tinged, with pale grey irroration; a very faint antemedian line, usually obsolete, or represented by two or three dots; a minute fuscous median discal dot, often obsolete; a faint grey shaded line from $\frac{2}{3}$ costa bent first outward then inward in a strong sigmoid curve to $\frac{3}{5}$ dorsum; a series of fuscous dots on veins at $\frac{5}{6}$; a terminal series of minute dark fuscous dots between veins; cilia ochreous-whitish with a faint pinkish tinge. Hindwings with termen rounded; colour and markings as forewings; median discal dot minute, fuscous. Underside whitish, forewings suffused with pale purplish, with subterminal and terminal series of purplish dots, the former on forewings only.

Type in British Museum.

N.Q.: Kuranda, Townsville—Q.: Brisbane; in October, Feb-
uary, and April; rather common.

101. PISORACA DECRETARIA.

nisodes (?) *decretaria* Wlk., Brit. Mus. Cat. xxii. p.650.

♂♀. 24 mm. Head whitish with a narrow transverse purple
ne on crown; face brownish, lower half whitish. Palpi in ♂ 1¼,
♀ 2; purple above, whitish beneath. Antennæ whitish;
ctinations in ♂ 6. Thorax and abdomen whitish. Legs
hitish; anterior and middle pairs suffused with purple. Fore-
ings triangular, costa nearly straight except near apex, apex
unded, termen bowed, oblique; whitish, irrorated and strigu-
ted with pale fuscous-purple; discal dot and a terminal series
dots of same colour; cilia whitish. Hindwings with termen
unded; colour and markings as forewings. Underside whitish
th some pale purplish suffusion.

N.Q.: Thursday Island; three specimens in poor condition,
entified for me by Sir Geo. Hampson. Also from Borneo.

Gen. 20. DIZUGA.

izuga Warr., Nov. Zool. 1896, p.372.

Differs from *Pisoraca* in the posterior tibiæ of ♂ having two
irs of spurs.

Type *D. parva*, Warr.

102. DIZUGA PARVA.

izuga parva Warr., Nov. Zool. 1896, p.372.

Type in Coll. Rothschild. I have no examples of this species.

N.Q.: Cooktown.

Species unrecognised or wrongly referred to this subfamily.

103. *Acidalia* (?) *schistacearia* Wlk., Brit. Mus. Cat. xxvi. p.1609,
a synonym of *Dichromodes estigmaria* Wlk. (*Monocteniinæ*).

104. *Acidalia primaria* Wlk., Brit. Mus. Cat. xxvi. p.1610, *nec*
eyr., Proc. Linn. Soc. N.S. Wales 1891, p.642, is a synonym of
liodes apicata, Gn. (*Selidoseminæ*).

105. *Acidalia posticaria* Wlk., Brit. Mus. Cat. xxxv. p.1633. I have not seen this type, which probably does not belong to this subfamily.

106. *Idaea farinalis* Rosen., Ann. Mag. Nat. Hist. 1885, p.402, belongs to the *Selidoseminæ*. The type, which is much wasted, is a ♀, and I was not able to identify it.

107. *Somatina rubridisca* Swin., Cat. Oxf. Mus. ii., p 376. Queensland.

108. *Perixera maculifera*, Swin., Ann. Mag. Nat. Hist. 1900, p.310. Duaringa.

109. *Sterrha punctilinea* Swin., Ann. Mag. Nat. Hist. 1902, p.167. Sherlock River, N.W.A.

110. *Sterrha franconiana* Swin., Trans. Ent. Soc. 1902, p.658. Sherlock River, N.W.A.

111. *Sterrha ioparia* Swin., Trans. Ent. Soc. 1902, p.659. Sherlock River, N.W.A.

112. *Acidalia partita* Luc., Proc. Roy. Soc. Qsld. 1899, p.141, is a synonym of *Oruza hydrocomptata*, Gn.(*Noctuidæ*).

113. *Leptomeris* (?) *uniformis* Warr., Nov. Zool. 1896, p.373. The type is a wasted ♀, from Mackay.

114. *Perixera* (?) *flavirubra* Warr., Nov. Zool. 1896, p.375. Cooktown.

115. *Brachycola paucinotata* Warr., Nov. Zool. 1901, p.22. Doubtfully Australian.

116. *Cinglis persalea* Warr., Nov. Zool. 1902, p.356. Roeburne, N.W.A.

117. *Lycauges* (?) *desueta* Warr., Nov. Zool. 1902, p.358. Roeburne, N.W.A.

118. *Ptychopoda interalbulata* Warr., Nov. Zool. 1904, p.487. Condon, N.W.A.

119. *Emmiltis trissodesma* Low., Proc. Linn. Soc. N. S. Wales 1899, belongs to the genus *Anomocentris* (*Hydriomeninæ*).

120. *Emmiltis cosmadelpha* Low., Trans. Roy. Soc. S.Aust. 1901, p.66. Broken Hill.

121. *Leptomeris isodesma* Low., Trans. Roy. Soc. S.Aust. 1903, p.217. Broken Hill.

INDEX OF GENERA.

INDEX OF SPECIES.

Synonymous and unrecognised or incorrectly referred species in italics.

NOTE ON A GLAUCOPHANE SCHIST FROM THE CONANDALE RANGE, QUEENSLAND.

By H. I. Jensen, B.Sc., Linnean Macleay Fellow of the Society in Geology.

Last year, on a trip to Queensland to review the field geology f the East Moreton District prior to the publication of my aper dealing with that area, (These Proceedings, 1906, p.73) I ent from Woodford, on the Stanley River, across the Conandale ange to the headwaters of the Mary River.

On the 'Postman's Track,' at the foot of the range on the lary River side, there is a quartz reef bearing a trace of gold inning across the track. It intrudes highly metamorphic and liated schists and phyllites. Close to the reef, and interbedded ith the other metamorphic rocks, there is a body of dark, blue-lack schist, having a silky lustre and true schistose fracture. his rock struck me at once as being an interesting amphibolite hist, and I accordingly took a specimen. A few hundred yards rther along the road, I met with a highly interesting mass of lspar porphyry intruding the metamorphic series. This rock as no relationship with the schists in question, but is closely lated to the porphyrites at Point Arkwright and Noosa Head, n the coast. It is, in fact, a granophyric porphyry containing lbite, orthoclase, quartz, augite, and hornblende, and belongs, erefore, to the monzonitic series. The structure and composi-on of this rock bring out its affinities with the Post-Triassic orphyries so strongly that it gives one good reason to believe at most of the granites of the Yabba Ranges, which belong the same monzonitic class, are of Post-Triassic age.

If most of the granites are Post-Triassic, it is easy to compre-end that rocks as young as Carboniferous (to which age all the ast Moreton schistose rocks are referred by Jack) or Devonian as Gregory terms them) have been foliated and metamorphosed s highly as the Archæan rocks of other parts of the world.

The glaucophane schist from the Conandale Range is a fine-grained, dark schistose rock. In appearance this rock has no resemblance to the Mount Mee glaucophane rocks described by me. Under the microscope it is seen to be tolerably even-grained, and to be laminated in such a way that layers of amphibole crystals alternate with layers of fine granular quartz and felspar. The structure is very like schlieric structure in gabbros. Magnetite is present, generally collected along the division-lines between the layers of hornblende and of colourless minerals.

The amphibole consists of hypidiomorphic grains of a bluish-green glaucophane having the following scheme of pleochroism—

$\mathfrak{c}$ sky-blue $>$ $\mathfrak{b}$ greenish $>$ $\mathfrak{a}$ yellowish.

The extinction angle is 10° ($\mathfrak{c}:c = 10°$) and the mineral is optically positive. In character it is, therefore, allied to both glaucophane and actinolite.

A chemical analysis of this rock was made, and the result is stated below, with the analysis of the glaucophane rock from Mount Mee stated for comparison (*cp.* my paper, *loc. cit.*).

	Glaucophane Schist, Conandale Range.		Glaucophane Rock, Mount Mee.	
		Mol.		Mol.
SiO_2	47·21	0·787	49·98	0·833
Al_2O_3	14·35	0·140	11·95	0·117
Fe_2O_3	3·11	0·019	13·91	0·087
FeO	10·78		2·75	
MnO	0·09	0·152	0·13	0·041
NiO(CoO)	0·10		0·10	
MgO	6·38	0·159	5·53	0·138
CaO	11·28	0·202	10·54	0·188
Na_2O	2·91	0·047	2·63	0·043
K_2O	0·49	0·005	0·26	0·003
H_2O+	0·32	0·020	1·18	0·067
H_2O-	0·34	—	0·03	—
CO_2	abs.		0·02	
TiO_2	2·20	0·028	0·80	0·010
S	—	—	0·23	0·007
P_2O_5	trace n.d.	—	pres. n.d.	—
	99·56		100·04	

For the sake of being able to compare these two rocks, I calculated their norms, first in terms of such minerals as usually occur in glaucophane schists, next in terms of such minerals as occur in igneous rocks. The chemical symbols for the minerals were taken from Dana's 'Text-Book of Mineralogy.' The following results were obtained :—

1. Glaucophane Schist, Conandale Range.

Glaucophane	32·91 %
Epidote	2·20
Perofskite	3·81
Actinolite	27·49
Anorthite	21·41
Orthoclase	2·78
Omphacite	2·23
Akermannite	2·12
Magnetite	3·78
	98·73
Water	0·64
Total	99·37

The composition of glaucophane was taken as SiO_2, 57·6 %; Al_2O_3, 16·3; FeO, 7·7; Mg, 8·5; and Na_2O, 9·9; and, in the epidote, the ratio of Al_2O_3 to Fe_2O_3 was taken to be 5 : 1 (for formulæ, see Dana, *op cit.*).

2. Glaucophane Rock, Mount Mee.

Glaucophane	28·61
Epidote	47·53
Perofskite	1·36
Chlorite...	7·03
Orthoclase	1·67
Quartz	13·91
Pyrites	0·36
Total	100·48

The glaucophane was calculated on the formula Na_2O, Al_2O_3, 2(FeMg)O, $6SiO_2$ with the ratio of Mg to Fe as 2 : 1.

The epidote was assumed to be, as observed in the mode, highly ferriferous; and to contain 0·049 mol. H_2O, 0·178 mol. CaO, 0·087 mol. Fe_2O_3, 0·060 mol. Al_2O_3, and 0·294 mol. SiO_2.

All the MgO (81 mol.), FeO (9 mol.), Al_2O_3 (11 mol.), and H_2O (28 mol.) left, after satisfying the other minerals excepting quartz, was allotted to chlorite, whose composition would be between that of chlinochlore and that of pennine.

	3. Glaucophane Schist, Conandale Range.	4. Glaucophane Rock,† Mt. Mee.
Quartz	nil	9·60
Orthoclase	2·78	1·67
Albite	24·63	22·53
Anorthite	24·46	19·74
Diopside	26·45	25·27
Olivine	11·48	nil
Hypersthene	nil	2·10
Ilmenite	4·26	1·52
Magnetite	4·41	6·50
Hæmatite	nil	9·44
Pyrites	nil	0·36
*Extra CaO for apatite	0·44	
Water	0·66	1·21
	99·57	99·94

3.	4.
Salfemic.	Salfemic.
Order -. Gallare.	Order 4. Vaalare.
Docalcic.	Docalcic.
Presodic.	Presodic.
Auvergnose.	

The Mt. Mee glaucophane rock I have already shown to be most likely an altered tuff of the gabbro family. It is associated with massive igneous rock altered to chlorite and amphibolite

* If insufficient P_2O_5 be present, this CaO serves to reduce some of the diopside to olivine.

† I have recalculated the norm of this rock because in my previous calculation I discovered some errors, which, however, do not affect its systematic position.

chists, and more or less rudely stratified rocks having the ppearance of altered tuffs.

The Conandale glaucophane schist is associated with perfectly ratified schistose rocks, which have certainly been laid down by e aid of water; but fossils I have never met with in them. his last characteristic, so common with the metamorphic rocks the East Moreton area, may indicate that these rocks, even hen stratified, are primarily of volcanic origin, having been distributed by water. The chemical composition of the Conanle glaucophane schist, as shown above, is such that it might sily have been derived from a basaltic tuff.

The calculation of the norm of these rocks in terms of glaucoane, epidote, actinolite, chlorite, perofskite, etc., brings the rm of these rocks into very close agreement with the mode.

There is reason to believe that the Mount Mee glaucophane ck, associated as it is with chloritic schists, etc., owes its patches deep blue colour partly to the incipient alteration of its conituents to chlorites like delessite and chloritoid.

The glaucophane of the Conandale specimen approaches tinolite in character, and is probably either an intermediate riety or a mixture of these hornblendes. This, too, is evident om the norm.

CHEMICAL NOTE ON A RECENT LAVA FROM SAVAII.

By H. I. Jensen, B.Sc., Linnean Macleay Fellow of the Society in Geology.

During the course of making some chemical analyses of Warrumbungle Mountains rocks, I also made an analysis of a recent lava, hyalopilitic olivine basalt (S 1) from Malaiola, Savaii, of which a short petrological description appeared in my paper on 'The Geology of Samoa' (These Proceedings, 1906, p.666).

The estimation resulted as follows:—

	%	Mol.
SiO_2	45·96	0·766
Al_2O_3	10·94	0·107
Fe_2O_3	5·85	0·036
FeO	6·39	0·089
MnO	0·08	0·001
NiOCoO	0·02	—
MgO	10·82	0·271
CaO	9·96	0·179
Na_2O	2·40	0·039
K_2O	1·92	0·020
H_2O+	0·36	0·003
H_2O-	0·12	
CO_2	abs.	
TiO_2	5·50	0·069
P_2O_5	pres.n.d.in amt.	—
Total	100·32	

The calculation of the norm of this rock resulted as follows :—

Orthoclase	11·12
Albite	20·43
Anorthite	13·34
Diopside	25·20
Olivine	12·04
Hæmatite	2·40
Magnetite	4·87
Ilmenite	10·49
Water	0·48
Total	100·37

$$\frac{\text{Sal.}}{\text{Fem.}}=\frac{44{\cdot}89}{55{\cdot}00}=<\frac{5}{3}>\frac{3}{5}$$

hence salfemic.

$$\frac{\text{Felspar}}{\text{Quartz}}=\frac{44{\cdot}89}{0}>\frac{7}{1}$$

hence Order Gallare.

$$\frac{K_2O+Na_2O}{CaO}=\frac{59}{179}<\frac{3}{5}>\frac{1}{7}$$

hence Docalcic.

$$\frac{K_2O}{Na_2O}=\frac{20}{39}<\frac{3}{5}>\frac{1}{7}$$

Magmatic name: Auvergnase.

The comparison of the analysis and norm with the petrological escription was of some interest.

The analysis bears out my statement that the augite is titani-rous, for the ilmenite actually present in the rock is much below at which we should expect if all the titanium had gone to form menite. My conclusion that the hæmatite present is a primary nstituent also follows from the norm. The felspar, however, calculated from the norm, differs totally from the felspar as served in the slide.

From the norm we should expect the dominant felspar to be a riety of andesine, but my examination of the rock-slide revealed ly basic labradorite or bytownite. This might be accounted r through two circumstances; first, the existence of a glassy siduum which may be very acid in composition; second, the ct that the augite is greenish-brown and highly pleochroic, hich phenomena suggest richness in alkali, especially soda.

After the analyses had revealed this disparity between the rm and the mode, as previously obtained, the rock was again amined under the microscope. The description already given the paper referred to was found to be essentially correct.

ON THE GENUS *PETALURA*, WITH DESCRIPTION OF A NEW SPECIES.

By R. J. Tillyard, M.A., F.E.S.

(Plate xxxiii.)

The genus *Petalura* was created by Leach in 1815 to contain a remarkable dragonfly of great size which he received from his friend, W. J. Hooker, from "New Holland" (N.S.W.). The insect was absolutely unlike any other dragonfly known to Leach, but he placed it in the family *Æschnidæ*, although he was careful to remark upon the many differences it possessed from all other members of that family. Since then it has remained for a long time classed with the subfamily *Gomphinæ*, until only lately Krüger has removed it and constituted a new family, *Petaluridæ*, to contain it, placing it between *Gomphinæ* and the *Calopterygidæ*.

Before we attempt to place the genus arbitrarily in any assigned position, we must recognise the difficulty that always occurs in dealing with aberrant genera. It is this. All naturalists admit the imperfections of a simply linear classification, in which an attempt is made to arrange in a definite line a series of genera or families on which the forces of natural selection have been exerting themselves through countless ages. That it can be done at all shews us indeed that all natural development has proceeded more or less on the same lines; and that if Nature is prodigal in variation, she is nevertheless chary in innovation. But it sometimes happens that a whole race, or a series of races, has been completely wiped out in the past, save, perhaps, for some solitary form, more stable that its congeners. Such a form, or forms, on

hose behalf natural selection has been exercised to so full and
vourable extent that it can hold its own, with little further
uriation, in the changing world around it, has, we may suppose,
cisted until the present day. To us then it will appear as an
berrancy, a form without near relations, and one whose origin
e can scarcely hope to explain, and whose position in a *linear*
assification it were almost hopeless to determine.

Petalura is a good example of these aberrant forms. Its great
ze and remarkable formation will make it one of the Odona-
logist's chief treasures and most careful studies. Let us examine
refully then the points which may throw light upon its position
the recognised classification of *Odonata* :—

1. Head rather small for the size of the insect, being scarcely
broad as the thorax. In the *Gomphinæ* and *Calopterygidæ*
e head is broader than the thorax, the nearest approach to
uality being in the genus *Ictinus* (a genus which I think shows
me points of approach to *Petalura*). As regards the eyes, these
e slightly smaller and further apart, considering the size of the
sect, than in the *Gomphinæ*, but larger and closer together than
the *Calopterygidæ*.

2. Thorax large and powerful. It shows a near approach to
e *Gomphinæ*. As regards the size of the prothorax, which is
irly well developed, we see again a similarity to the *Caloptery-
idæ*. The legs are strong and thick, but afford no criterion for
mparison; the *Odonata* on the whole use them but little, and
ey show little variation.

3. Abdomen: a point of great interest is the presence of
udimentary spurs on the second segment of the male. The
omphinæ have well-developed spurs, the *Calopterygidæ* have
one. In *Petalura* we have the spur about half-formed. As
egards the general shape of the abdomen, *Petalura* is widely
ifferent from the *Gomphinæ* and very similar to many of
he genera of the *Calopterygidæ* (compare for this purpose
Diphlebia).

4. Appendages: in these we have the most remarkable divergence of all. The appendages of *Petalura* (male) cannot be brought into line with those of other *Odonata* at all. It resembles the *Libellulidæ* and *Æschninæ* in having only one inferior appendage; both the *Gomphinæ* and *Calopterygidæ* have two. Moreover it would require a stretch of the imagination to see in the breadth of its single appendage an approach to bifurcation, though it is possible that the double inferior appendages of the *Gomphinæ* may have been brought about by that means. As regards the superior appendages, they are beyond all doubt most remarkable, and would almost appear to have been developed for use as a rudder during flight. The insect is able to open and shut them, and when flying holds them fairly vertical, but I have not been able to observe what use is made of them when the insect is about to descend, or when it is hovering in the air. Here again imagination may depict the process of forcipation, as we see it in the *Calopterygidæ*, being brought about by the change, firstly, to a laminate appendage, as in *Petalura*, and, secondly, by the hardening of the upper and stronger curved edge of the lamina, and the gradual loss of the under portion. In this case we might also regard the teeth that occur often on the undersides of forcipate appendages as the relics of the lower portion of the lamina. A careful study of a number of forcipate forms may reveal the truth of this supposition, but at present it cannot be pressed. The appendages of the female are not remarkable, and do not call for comment.

5. Wings: these show no connection whatever with the *Calopterygidæ*, but a considerable resemblance to the *Gomphinæ*. Fore- and hindwings *dissimilar*. (a) *Pterostigma* of enormous length; narrow as in the *Æschninæ*, and not convex as in the *Gomphinæ*. Here, however, the genus *Ictinus* is again an exception, as it shows a considerable lengthening and narrowing of the stigma. (b) *Wing-triangles* distinctly dissimilar, that of the forewing being narrower than that of the hindwing, as in the *Libellulidæ*. However, an examination of the simple triangles of

ne *Gomphinæ* should show us that they also are not really
milar except in an approximate sense. The triangles of
etalura appear to me to be closer in formation to those of a
ajority of the *Corduliinæ* than to those of any other subfamily.
) *Anal angle* (♂) *and membranule*: angle very marked, mem-
anule very small, as in the *Gomphinæ*.

Reviewing the above points, there seems to be no doubt that
talura is a far closer approach to the *Gomphinæ* than to the
lopterygidæ. And of the genera comprised in the *Gomphinæ*,
tinus should be singled out as the nearest approach to *Petalura*,
rticularly in the shape of the head and thorax, the length of
e pterostigma, and the dissimilar triangles crossed by one or
re nervules. Apart from these points, the differences between
talura and *Ictinus* are so insuperable that the family *Petaluridæ*
ist stand. It should probably be placed at the end of the
vision *Anisoptera* which the American authors use to include
e *Libellulidæ* and *Æschnidæ* with their subfamilies. The
vision *Zygoptera*, of which the *Calopterygidæ* are the first
nily, will follow it in the linear order; but it must be borne in
nd that the gap between *Petalura* and these latter is far greater
in the gap between *Petalura* and *Ictinus*.

While I was collecting in the Cairns district of North Queens-
d, during the summer of 1904-5, I was told of the occurrence
ere at rare intervals of a dragonfly of such enormous propor-
ns that I scarcely credited the story. It was said to come
ooping down "like a bird," and local residents went so far as
declare that "its bite would pretty well kill you." When I
ptured *Anax guttatus* at Atherton I thought this was the
ecies refered to, but when I showed it to a Cairns resident he
clared that the one he had spoken of was far bigger than that.
ept on the look-out, and a few days before I left Kuranda I
s rewarded by seeing an enormous dragonfly along the banks
the River Barron. I was unable to capture it, but I could
that it was a *Petalura*. A day later a local collector brought
a female of the species, which he had captured in the bush.
was in bad condition, but measured about 6½ inches across the

wings. This year I have received from my friend, Mr. E. Allen, of Cairns, a beautiful male, in fine condition, taken near Herberton. With this material to work upon, I was soon able to determine that this enormous dragonfly, without doubt the largest known, is a new species of *Petalura*, very distinct in many respects from Leach's *P. gigantea*.

In this paper I propose to give a careful definition of both species, a good description of *P. gigantea* being very much needed.

Firstly as to the position and definition of the family *Petaluridæ*. The following key will determine it :—

Division *Anisoptera* (fore- and hindwings dissimilar).

	Eyes very close together..	1.
	Eyes just touching	*Cordulegasterinæ*.
	Eyes separate	2.
1.	Triangles elongated, similar	*Æschninæ*.
	Triangles dissimilar	3.
2.	*Two* inferior appendages in male	*Gomphinæ*.
	One inferior appendage in male, superior appendage broadly laminate	*Petaluridæ*.
3.	Hindwings of male rounded at anal angle	*Libellulinæ*.
	Hindwings of male angulated (except *Hemicordulia*)	*Corduliinæ*.

Genus PETALURA.

Insects of great size. Head rather small, eyes separated, ocelli in a triangle. Thorax strong and broad, prothorax fairly well developed. Abdomen rather narrow, elongate subcylindrical. Spurs of segment 2 present in male, but not well formed. Appendages of male: superior broadly laminate, inferior broad, covering the basal portions of the superior beneath. Triangles dissimilar, that of the forewing crossed by two nervules, that of the hindwing by 1-3 nervules (rarely free). Subtriangle of forewings reticulated, of hindwings free. Basilar space free; submedian space crossed by one nervule. Pterostigma exceedingly long and narrow. Anal triangle of hindwing in male very long, narrow, divided into three cells.

1. Petalura gigantea Leach (Zool. Misc. ii. p.96).

(Plate xxxiii., figs.2, 5-6.)

♂. Total length 87-97 mm.; abdomen 63-73 mm. Forewing 52-58 mm.; hindwing 50-56 mm.

W i n g s : *Neuration* black, strong, costa pale yellowish outwards, ribbed with black. Triangle of forewings with two cross-nervures, of hindwings with one cross-nervure (rarely free). Hindwings strongly angulated anally. *Pterostigma* very long and narrow, black, 9 mm. in forewing, 10·5 mm. in hindwing. *Membranule* small, pale; forewing 1·5 mm.; hindwing thicker, 2 mm. *Nodal Indicator* | circ. 19 circ. 10 / 14-16 9-10 | H e a d : *Occiput* thick, downy, black, slightly raised in middle. *Eyes* 2 mm. apart, dark brown, a yellow line behind on the orbital ridge. *Vertex* small, black; the two outer ocelli set on raised tubercles, the middle one slightly in front, smaller, not raised, black; antennæ 3·5 mm., black. *Front* large and broad, slightly indented medially; the base, next the vertex, is covered by the black colour of the vertex, forming a transverse band along the base; rest of front pale yellow finely granulated with black dots. *Clypeus* very dark brown shading to black; an obtusely pointed lamina on each side, projecting downwards to labrum; *labrum* pale yellow, a fine black point entering medially from above; lower parts of mouth dull dirty yellowish, mouth edged with black or dark brown. T h o r a x : *Prothorax* blackish, with a touch of yellow on the collar behind; covered with downy greyish hairs. *Meso-* and *metathorax* large, strongly built, downy, colour chocolate-brown above, dorsal and interalar ridges touched with black, the former elevated near the middle into an obtuse spine; on either side of the dorsal ridge, and touching it, is a broad band of dull orange-brown, the outer margin being slightly curved; some greyish hairs in front next the prothorax and also on the notum near the wing-joins. Sides glaucous brown with a distinct straight lateral band of dirty yellowish-grey which is continued across the notum; rest of notum black. Lower parts of sides brownish, with grey hairs; near the abdomen is a second

sublateral stripe, parallel to the former and of the same colour, but not so large or distinct. Underside covered with grey hairs. *Legs* strong and thick, with very small stiff hairs or spines; black, except coxæ, which are pale brownish. Abdomen: fairly thick at base, then tapering slightly to 4, 4 to end cylindrical. Colour: 1, blackish, grey hairs on sides, a touch of yellow on each side near 2; 2, spurs distinct, but not very large and projecting very little; dark brown, a dorsal stripe of dull orange yellow and on each side a broad patch of yellow; a touch of yellow on spurs: 3-4, basal half dark brown, anal half almost black, dorsal stripe as in 2, but narrowing; on either side an irregular stripe of orange-yellow, broken by the transverse central carina which is pale brown, and by the sutures, which are black and rather broad; these stripes broaden out anally, forming narrow transverse bands of orange-yellow, the two portions just meeting on the dorsum: 5-7, nearly black above, the dorsal stripe still present, but very narrow, the lateral stripes very irregular, the anal band exceedingly narrow, the two portions *not* meeting on the dorsum, transverse central carina black; 8, black above, an irregular patch of orange-yellow on each side, broadening anally into a fine transverse line, the two portions just meeting on the dorsum in a small orange-yellow spot; 9, orange-yellow, an irregular transverse narrow basal black band, projecting slightly on each side into a small round black spot; 10, same size as 9, black, bordered anally by a transverse orange-yellow band. Underside black, strongly powdered with grey. Viewed broadly, the abdomen may be said to possess a narrow dorsal stripe, tapering, from 2 to 7, and a very irregular lateral stripe on each side, broken by the carinæ and sutures. Appendages most remarkable. *Superior* large and broad, laminate, curved, somewhat rudder-shaped, length about 6 mm., bases strong and thick, separated; about midway on the inner margin is a projecting portion forming a right angle; colour, inner basal half pale orange-brown, semi-transparent, outer and upper half very dark brown; edges and bases black. *Inferior* about 2·5 mm. long by 4·3 mm. wide at tips; acutely pointed on

each side; somewhat convex, and hiding the bases of the superior appendages (viewed from below); colour orange-brown, semi-transparent, base and tips blackish (Pl.xxxiii., figs.5-6).

♀. Total length 82-96 mm., abdomen 58-70 mm.; forewing 56-60 mm., hindwing 54-58 mm.

It differs from the male as follows:—Pterostigma, fore 11·5 mm., hind 12·5 mm.; hindwings rounded anally. Head and thorax as in male. *Abdomen* broader, very regular, cylindrical, *slightly* tapering from 2 to 8. A few grey hairs on 1-2, rest smooth; 3-6 brown above, with anal one-fourth black and a fine black line along the transverse central carina. The dorsal stripe is distinct and regular but narrow; the lateral stripes less irregular than in the male; 8, black, with an anal band of orange-yellow, extending half-way down each side and flanked by a flat triangular yellow portion which appears to have been just cut away from it (due to the interception of the supplementary carina, which is here very close to the suture); 9, very short, basal three-fifths black with a dorsal yellow spot, rest yellow; 10, short and narrow, black, projecting anally beyond appendages in a brownish tubercle. Ovipositor large and thick, upcurved, reaching to end of abdomen and carrying near the tip two minute filaments consisting of a short stumpy base from which emerge a few stiff straight hairs. *Appendages* very short, 1 mm., black, conical, bluntly pointed.

Hab.—New South Wales; rare: Blue Mountains, Moss Vale, Sydney; November-January.

2. Petalura ingentissima, n.sp.

(Plate xxxiii., figs.1, 3-4.)

♂. Total length 120 mm.; abdomen 92 mm.; forewing 74 mm., hindwing 71 mm.

Wings: *Neuration* black, costa yellowish outwards ribbed with black. All triangles crossed by two nervures; subtriangles of forewings with 6-7 cellules. Hindwings strongly angulated anally. *Pterostigma* narrow, black, very long, fore 13 mm., hind

14 mm., covering 8 cellules. *Membranule* very small and narrow, dirty flesh-coloured. *Nodal Indicator* $\left\|\begin{matrix} 21 & 12\text{-}14 \\ 16\text{-}17 & 12\text{-}14 \end{matrix}\right|$ Head: *Eyes* dark brown separated by occipital ridge, 3·5 mm. long, black. *Vertex* small, black; ocelli close together, rather large, brown; antennæ black. *Front* black with a broad transverse yellow band above, slightly narrowed in the median cleft; *clypeus* black; *labrum* yellow bordered with black, the black colour projecting slightly from above into a small central spine; *genæ* yellow; *labium* pale dirty yellowish-grey; mouth edged with dark brown. Thorax: *Prothorax* fairly broad, very dark brown, paler on the ridge behind. *Meso-* and *metathorax* rich dark brown, a subtriangular dorsal area of dull yellowish with its base next the prothorax, enclosing the dark brown dorsal ridge, which rises into a sharp spine near its centre. On either side a broad straight lateral band, and a sublateral band very low down, both dirty flesh-colour; the former band crossing the notum. *Legs* large and strong, jet black. Abdomen very long, slender, subcylindrical; 1-2 thickened, 3-6 tapering slightly, 7-10 enlarging slightly. Colour black or very dark brown, dorsal surface of 1 and base of 2 with pale grey hairs; 1, a yellow patch on each side; 2, a fine yellow dorsal line, a transverse anal band, enlarging on each side into a large yellow lateral patch; separated from this patch there is also a large basal yellow patch; spurs partially formed, with a deep depression behind them, but with little elevation; colour yellow, brown at the bases: 3, a narrow transverse yellow basal band and a similar anal band, joined on each side by an irregular lateral band of yellow, crossed by the slanting black line of the supplementary carina; 4-7 with narrow transverse basal and anal yellow bands, 4 sometimes showing the beginnings of a lateral band on the sides; 8-9 with narrow transverse anal yellow bands; 10 touched anally with yellow; 10 rather flat above, and both 9 and 10 short and of about equal length. Appendages very remarkable. *Superior* broad, laminate, somewhat rudder-shaped, 8·5 mm. long by 7 mm. wide; wide apart at bases, and carrying on the inner margin a portion forming an obtuse-angled projection. Colour very dark

brown, almost black, bases quite black. *Inferior* short, 3 mm., rather broad, terminated on each side by a short spike; convex beneath; black (Pl.xxxiii., figs.3-4).

♀. Total length 125 mm.; abdomen 94 mm.; forewing 78 mm., hindwing 76 mm.

Very similar to the male in coloration, differing as follows:—Hindwings rounded. *Abdomen* broader and more cylindrical than in male. Ovipositor large, blunt, reaching to end of abdomen, upcurved, black, carrying two tiny filaments as in *P. gigantea* female. *Appendages* short, 1·5 mm., pointed, black; separated by the large rounded anal projection of 10.

Hab.—North Queensland; very rare: Cairns, Kuranda, Atherton and Herberton. December-January. The type male was taken at Herberton, the female at Kuranda.

The two species, though closely allied, can be distinguished at once by differences of size and coloration. The following points should be specially noticed:—

The expanse of wing in *P. gigantea* is ♂ about 110 mm.; ♀ about 120 mm.
,, ,, *P. ingentissima* ♂ 151 mm.; ♀ 163 mm.

The front of *P. gigantea* has a great deal more yellow on it than that of *P. ingentissima*; this is shown clearly in the plate. The upper thoracic markings are different in shape; *gigantea* having two well defined bands, *ingentissima* a triangular area, formed by two short bands which narrow very rapidly. The subtriangle of the forewings has 3 cellules in *gigantea*, 6-7 in *ingentissima*. The anal angle of the hindwings of the male is slightly more pronounced in *gigantea*. The yellow markings of the abdomen are very different; *gigantea* has the dorsal and lateral bands along nearly the whole of the abdomen; *ingentissima* has but the beginning of them on the first two or three segments. Again *ingentissima* has transverse bands on every segment except 1 and 10; *gigantea* has not. Finally, *gigantea* has the 9th segment bright orange-yellow; *ingentissima* has it nearly black. The appendages on examination will be found to differ remarkably, as may be seen in the plate: As regards the superior appendages, those of *ingentissima* are broader, and less angulated on the inner margin; their colour, too, is black, while those of *gigantea* are semitransparent brown: The inferior appendages are very different both in form and coloration (see figures).

In conclusion, the addition of this wonderful new species to the list of Australian *Odonata* is of great interest, showing us, as

it does, that the *Petalura* of Leach is not the last of its race, but that a greater and even more remarkable species, closely allied to it, still exists to add to our knowledge of this isolated form.

EXPLANATION OF PLATE XXXIII.

Fig. 1.—*Petalura ingentissima*, n.sp.; ♂ nat. size.
Fig. 2.—*Petalura gigantea* Leach; ♂ nat size.
Figs. 3-4—*Petalura ingentissima*, n.sp.; ♂ appendages.
Figs. 5-6.—*Petalura gigantea* Leach; ♂ appendages.

(Figs. 1-2, photo H. King; figs. 3-6, R.J.T. del.).

THE DRAGONFLIES OF SOUTH-WESTERN AUSTRALIA.

By R. J. Tillyard, M.A., F.E.S.

(Plates xxxiv.-xxxvi.)

Few parts of Australia have been more neglected, from an entomological point of view, as the West. The fact that enormous tracts of land there are practically without a useful rainfall, and carry but an insignificant insect fauna, seems to have deterred collectors from working this portion of the continent as carefully as they might have done. Probably a very large portion of the west would not repay the trouble and expense of visiting it; but it must nevertheless be borne in mind that the State of Western Australia in itself contains between one-third and two-fifths of of the whole continent, and that in this vast area there are many rich districts, blessed with an abundant rainfall, and exceedingly rich in insect life.

One of these rich districts is the South-Western District, lying roughly between Perth on the north-west and Albany on the south-east, and in particular that portion of it which has a regular annual rainfall of from 30-50 inches. Here are found immense forests of jarrah and karri timber, covering vast areas of rich soil which will be capable of great possibilities when the district is opened up. As no systematic collecting of Odonata has so far been carried out in Western Australia, I did not attempt to cover a vast area superficially in the three weeks I had at my disposal, but rather to take a well-defined and not too large district and work it thoroughly. In deciding on the South-Western District, I was mainly guided by the rainfall. This is very regular, and falls in the winter months. The summer is dry and fairly hot; and after the last rains have fallen the rivers

begin to dry up rapidly. In less favoured localities the river-beds become quite dry in the summer, with possibly a pool of water here and there; and even in the best localities I found very few of the creeks actually running.

A glance at the map (Plate xxxiv.) shews that a fair number of rivers drain the South-Western District. Taking them in order from north to south, we have the Swan, Serpentine, Murray, Collie, Preston, Margaret, Blackwood, Warren, and Frankland. These may all be classed as mountain streams; for they all drain the plateau of the Darling Ranges, which extends from north to south at a distance of twenty to forty miles from the coast, except at Cape Naturaliste, where a spur runs out right to the Cape itself. The sources of the longer rivers would therefore be at elevations of from twelve to fifteen hundred feet, and in the winter they bring down a big volume of flood-water. However, the river channels are narrow and deep, and the only stream that has any pretensions to being a really fine river is the Blackwood. At Bridgetown, a hundred miles from its mouth, it carries all through the year a large volume of water and is in many places over one hundred yards wide.

Besides these running mountain-streams, all of which carry nearly the same Odonate fauna, we have the coastal lagoons, some of which are fresh, like Mungar's Lake, near Perth. These carry a somewhat different Odonate fauna. A third class, the marshes and swamps, usually very rich in Odonata, is practically absent, except in the Warren River district and around Lake Muir, where there are some fine tracts of swampy country. These are very inaccessible, but I was able to work the fringe of them at Wilgarrup, where there is a small brook running through some splendid marshy tracts. This is one of the best collecting places I found in Western Australia.

Taking as my base the South-Western railway line (that is the line from Perth to Busselton and Bridgetown, running almost due south) I was able to work from Perth down to Cape Leeuwin, and inland to Bridgetown and beyond, with care and thoroughness. I was unable to get farther eastward to Albany, but the

collection in the Macleay Museum, Sydney, contains a number of Odonata from this latter locality; and as these are all species which I obtained myself further to the west, I propose to include Albany in the South-Western District. The following localities were worked carefully and thoroughly:—Perth and Fremantle (Mungar's Lake and Swan River), Armadale (Canning), Busselton (Vasse), Bridgetown (Blackwood), Wilgarrup (Warren district), and the Margaret River and Karridale district. Besides these, I am much indebted to Mr. G. F. Berthoud, of the State Farm, Hamel, for sending me a large number of specimens from Waroona (Murray district), thus linking together the northern and southern localities which I myself worked.

Considering that the district worked was practically new ground, the final result of twenty-six species is perhaps somewhat disappointing. Six new and extremely interesting species were found; three or four more may be considered as exceedingly rare and local. The rest are insects found more or less commonly in similar latitudes in the Eastern States. Hence we are enabled to extend the range of many of our eastern species, and to notice their variation under different climatic conditions. The following is a complete list of all the species taken or observed, with notes on all points of interest, and complete descriptions of new species:

Family LIBELLULIDÆ.

Subfamily LIBELLULINÆ.

1. Pantala flavescens Fabr.

Rare; several taken at Waroona by Mr. Berthoud. It is an exceedingly common tropical species, extending to India and North America. In the Eastern States it is common from Cape York down to Clarence River, N.S.W.; and it is met with occasionally round Sydney. A large brownish-orange insect, with very broad hindwings.

2. Tramea Loewii Brauer.

Mungar's Lake, Perth. A beautiful large red insect, with a graceful soaring flight. The hindwings have a peculiar black

network at the bases, which are broad as in the preceding species. Common in the Eastern States, from Clarence River, N.S.W., northwards.

3. DIPLACODES NIGRESCENS Martin.

Very rare and local. Two males at Mungar's Lake, Perth; one at Armadale; one at Margaret River; one seen on the wharf at Fremantle. There are several females in the Macleay Museum Sydney, *loc.* Albany. It is also very rare in New South Wales and Victoria (R. Martin). The male is an insect of great beauty, having a very broad and flattened abdomen, brilliant red with large black spots. Female brownish.

4. DIPLACODES HÆMATODES Burm.

Fairly common, but somewhat local. Armadale, Waroona, Margaret River; also Albany. Found all over Australia; very common in the central and tropical parts. The male has the abdomen somewhat broad and flattened, brilliant red *without spot*. Female brown, tips of wings saffroned.

[*D. rubra* Kirby, is synonymous with this species.]

5. DIPLACODES BIPUNCTATA Brauer.

Fairly common. Perth, Armadale, Waroona; rare at Bridgetown and in the southern localities. Found all over Australia; swarms in Victoria, New South Wales and Queensland. The male has the abdomen narrow and rounded; colour brick-red, with small black spots. Female brown.

6. ORTHETRUM CALEDONICUM Brauer.

Exceedingly abundant around Perth; rarer further south. Round the sandy shores of Mungar's Lake these beautiful dragonflies may be seen in thousands. The male is a large pale blue insect, female olive-brown. It is one of the commonest of Australian Odonata, swarming all over the Eastern States, and also in Central Australia in very arid regions. It seems particularly fond of dry, hot sand.

7. NANNODYTHEMIS AUSTRALIS Brauer.

Wilgarrup, common. Absent elsewhere. It is widely diffused, but very local, in the Eastern States, especially New South Wales. The western form is larger and handsomer than the eastern form. It is a small stumpy-looking insect, appearing at first sight like some wasp-like creature armed with a formidable sting. The male has the abdomen very short and constricted, the end being enlarged into a thick club, brilliant red. It sits about on the grass and reed-stems in marshes, with wings much depressed. Female brownish.

Subfamily CORDULIINÆ.

8. HEMICORDULIA AUSTRALIÆ Rambur.

Fairly common on the mountain streams in the south, especially the Blackwood. Common all over the Eastern States. A beautiful insect, with deep orange abdomen carrying a broad and very irregular dorsal band, the portions on each segment being more or less clepsydrate. The front of the head carries a pair of brilliant metallic-blue spots, rather square and close together. Female duller. Hindwings of both sexes rounded at the anal margin.

9. HEMICORDULIA TAU Selys.

Common everywhere; found throughout Australia, even in the dry central regions. It is larger than the preceding, and far less beautiful. Markings of abdomen similar but duller. The front of the head carries a thick black T on a pale yellow ground; hence the name.

10. PROCORDULIA (SOMATOCHLORA) AFFINIS Selys.

A very rare species, confined to a few localities in South-West Australia. I took a dozen or so at Wilgarrup, all in a damaged condition, which shews that this insect is out on the wing early, probably in September or October. Also one male at Margaret River. At first sight it is very similar to *Hemicordulia australiæ*, but the following points will distinguish it:—the abdomen is not so slender, and the whole form less graceful than that of

H. australiæ. The frontal spots are possibly less brilliant, and more greenish than blue, but this may be due to the age of the specimens I took. The males can be distinguished at once by the superior appendages. Those of *H. australiæ* are fairly long, somewhat curved, tips pointed, and carry underneath, about their middle, a sharp black spine, easily seen with the naked eye. Those of *P. affinis* are, however, very short, much arched, almost forcipate, but with the tips slightly recurved; they carry *no spine* underneath, and are only half the length of those of *H. australiæ.* Besides this, the males of the genus *Hemicordulia* have the anal margin of the hindwings rounded, while *Procordulia* has it *very slightly*, but distinctly, angulated. The females of both species have rounded anal margins to their hindwings, and are exceedingly difficult to distinguish. *P. affinis* female has a slightly longer membranule and appendages.

11. Synthemis macrostigma Selys.

Sparingly at Bridgetown; abundant at Wilgarrup. The males outnumber the females by twenty to one. I was fortunate in obtaining two mature females at Wilgarrup, where the males were so common in marshy places that two could be caught with one sweep of the net. This insect is rather rare and local. It was first recorded from Fiji, but I have since taken it in New South Wales on the Blue Mountains, and have received one male from Mount Macedon, Victoria. The Western Australian form is considerably smaller than the eastern form. It is a beautiful insect, very slender and graceful, of a rich cinnamon-brown colour, profusely marked with beautiful cream-coloured spots in pairs. There are no bands on the upper part of the thorax, but on each side there is a round spot and a short band, both cream-coloured.

12. Synthemis cyanitincta, n.sp.

(Plate xxxv. figs. 3-4; Plate xxxvi. fig. 1).

This beautiful little species is exceedingly rare. I took it sparingly in one locality at Margaret River, and I also found one very damaged female at Armadale. It is easy to capture,

shewing no fear, and often hovering or flying slowly and gracefully to and fro within a yard or two of the net.

♂. Total length 41 mm., abdomen 31 mm.; forewing 27 mm., hindwing 26 mm. Wings very slightly suffused with pale brown. *Neuration* black, bases slightly saffroned; the space between the subcostal and median nervures black for nearly 2 mm. at the base. *Pterostigma* 2 mm., brown. *Membranule*, fore very narrow, 2 mm.; hind narrow, 3 mm., dull whitish. One cross-nervule in basilar space, 2-3 in submedian; a conspicuous white spot at the base of each wing. *Nodal Indicator*

10-11	6-7
6-7	6-7

Head: *Eyes* bordered with white beneath. *Occiput* very small, hairy, brown, with a cream-coloured triangle behind. *Vertex* dark brown. *Front* deeply cleft, with a creamy oval spot above on each side, extending downwards along the side of the front. *Clypeus* and *labrum* brown, *labium* dull brownish. Thorax: *Prothorax* very small, brown, touched with cream on the collar. *Meso-* and *metathorax* hairy, dark chocolate-brown, a pair of short straight humeral bars, cream-coloured, and less than 2 mm. in length; on each side a longer lateral bar of the same colour; and lower down, near abdomen, a triangular cream-coloured patch. Interalar ridge touched with white. Notum brown, a creamy spot on meso- and metascutum. *Legs* black, bases of femora brown. Abdomen slender, 1-2 slightly enlarged, 7-10 somewhat clubbed. Colour: 1, brown; 2, brown with a pair of semicircular creamy spots. Rest of abdomen dark brown shading to black, each of the segments 3-7 carrying a pair of central dorsal spots, oval or suboval, of a beautiful very pale greyish-blue colour; those of 3-5 touching along the dorsal ridge; each spot crossed by a transverse black line in the supplementary carina; 8, a pair of large oval spots similar to those on 3-7, but more than half the length of the segment; 9, a pair of small round basal spots of the same colour; 10 sometimes carries a more or less distinct basal band of cream marked with two very small brown spots. The underside of 8 carries a conspicuous patch of hairs; 9 with the testes whitish. Appendages: *Superior* rather long, 3 mm., wavy, narrow sublanceolate, black,

pointed. *Inferior* 1·8 mm., concave above, tip upcurved; brown, subtriangular.

♀. Differs from the male as follows:—*Wings* much suffused with brown; pterostigma pale brown, slightly longer than in male. A tiny cream-coloured triangular spot on the *anteclypeus*. *Abdomen* cylindrical, thicker than in male, 2-8 spotted as in male, but the spots of each segment of a more equal size, those of 8 *smaller* than the rest; 9-10 dark brown. Appendages separate, short, 1 mm., straight, pointed, black.

A very distinct species, and by far the smallest member of the genus. The pale blue colouring of the spots is remarkable, and I do not know of another species of the *Corduliinæ* which possesses it.

Hab.—Small mountain-brooks; Margaret River district and Armadale; December-January.

13. Synthemis Martini, n.sp.

(Plate xxxv. figs. 1-2; Plate xxxvi. fig. 2).

♂. Total length 55-57 mm.; abdomen 42-44 mm.; forewing 33-34 mm.; hindwing 32-33 mm.

Wings: *Neuration* black; a very conspicuous cream-coloured spot at the base of each wing. *Pterostigma* 27-30 mm., black. *Membranule*, fore 15 mm., white; hind nearly 3 mm., pale greyish. *Nodal Indicator* | 11-14 6-9 / 8-10 8-11 | One cross-nervule in basilar space, 3 to 4 in submedian. Head: *Eyes* bordered behind with brown for 3 mm., followed by cream-colour for 2 mm. *Occipital tubercle* brown in front, rounded and cream-coloured behind. *Vertex* small, tubercled, hairy, brownish-black. *Front* hairy, widely cleft medially, dark brown; on each side a large round creamy spot; lower part of front dull fleshy-grey, brown in the cleft. *Clypeus* dull fleshy-grey tinged with brown; *labrum* and *labium* pale dirty flesh-colour. Thorax: *Prothorax* dark brown, a pale straw-colour in front. *Meso-* and *metathorax* very dark brown, in parts almost black, with a slight metallic tinge. A fine straw-coloured line for about 2·5 mm. on

the dorsal ridge, and four fair-sized creamy dorsal spots, at about equal distances apart, forming approximately the angular points of a square; of these the two front are often cleft by the intrusion of the ground-colour from behind, but the other two are more or less round. On each side of the thorax is a broad lateral band of cream-colour or pale straw, running from between the wing-joins to above the metacoxa; part of the thorax next the abdomen is dull greyish. Notum brown, except meso- and metascutum, which are cream-coloured. *Legs* black. Abdomen long and slender, 3 and 8-10 rather narrower than the rest. Colour: 1, brown with a creamy dorsal spot; 2, brown, on each side a creamy basal mark running up from the spur to dorsum, and nearly meeting above. Spurs small, creamy above, dull grey-brown beneath. Rest of abdomen black spotted with cream-colour as follows:—3-8, two basal triangular spots, and two central suboval or round spots crossed by a fine black line, the first two diminishing rapidly in size from 3-8, being only mere lines in 8, the last two somewhat pointed basally in 3, round in 4-7, smaller and pointed anally in 8; 9, black, sometimes with two tiny spots; 10, a rather large central diamond-shaped or oval spot, a pair of tiny lateral spots. Ventral carina black, broadly edged with dirty white, this colour being broadest at the base of each segment, and running up to join the basal spots on 3-8. Appendages: *Superior* very long, 3·8 mm., basal two-thirds straight, rest forcipate; black, with some very small hairs. *Inferior* 2·2 mm., narrow, subtriangular, slightly hairy below; concave above, tip slightly upcurved, colour pale brownish, darkened at tip.

♀. Differs from the male as follows:—A somewhat larger insect; forewing 36 mm., hindwing 35 mm. Bases of wings more or less shaded with rich yellowish-brown, especially between subcostal and median nervures. Pterostigma pale, 4 mm. Colours of thorax and abdomen duller. Spots on thorax larger and sometimes running into one another so as to form two very irregular antehumeral bands. *Abdomen* cylindrical, broader than in male; designs larger and bolder; 9-10 very short and narrow. Ovipositor

of 8 ending in a black hook, sharply upcurved. *Appendages* short, 0·7 mm., straight, black; separated by a projecting tubercle on 10, black and hairy and as long as the appendages; below this is a second tubercle, rounded, hairy, dark brown.

Hab.—Running streams and mountain-brooks all over the S.-W. district. A few specimens seen on Mungar's Lake, Perth. Abundant at Margaret River and Bridgetown.

The females are very rare, and, as in the preceding species, the males outnumber them by 20 to 1. In both cases this is probably accounted for by their being seldom on the wing, and retiring into the thick bush. The few females I have taken have been generally very immature, and we may perhaps see in this a wise provision by Nature for the preservation of the species. If the females only mature slowly, they are enabled to outlast the dry months at the end of summer, when many of the streams in which they breed have ceased to run, and they probably only deposit their ova late in the autumn, when the rains have commenced. There would always be plenty of males left over, even though they mature earlier, to provide for the fertilisation of the ova. This is borne out indirectly by the fact that, in the case of the three Synthemids which occur in S.-W. Australia, I never once took a pair in cop., even at the end of January, though all other species were frequently found so.

This exceedingly graceful insect has an easy flight, going to and fro in small clearings near the brooks, or up and down some small and shady reach. They never go far from water, and are very easy to capture. On hot summer days they sometimes hawk about swiftly over the streams, but it is the exception to see them flying at all fast.

Family ÆSCHNIDÆ.

Subfamily GOMPHINÆ.

14. Austrogomphus collaris Selys.

Common on most of the mountain rivers and brooks. Also recorded from South Australia and Victoria. It is fond of sitting about on trees and bushes overhanging the water, or on

hot sandy patches. It has a swift, dodging flight, and on hot summer days individuals may be seen chasing each other ceaselessly in and out of the river banks. The colours are black and yellow, which in the very mature insect turns more to olive-green, especially on the thorax. The appendages of the male are yellow, subconical, with a large cornute tubercle or branch underneath. The female carries, behind the occiput, three tubercles of nearly equal size.

15. Austrogomphus occidentalis, n.sp.

(Plate xxxv. figs. 5-6; Plate xxxvi. fig. 3).

♂. Total length 45 mm.; abdomen 34 mm.; forewing 27 mm.; hindwing 26 mm. Wings: *Neuration* black, costa pale greenish outwards; bases of wings very slightly saffroned. *Pterostigma* large, broad, nearly 3 mm. long, rich brown between black nervures. A minute yellow spot at the base of each wing. *Nodal Indicator* ‖ 11-14 7-10 | 9-10 8-10 | Head: *Occipital ridge* 1 mm., yellow, suture next the vertex brown and hairy. *Vertex* black, with a round yellow spot behind, next occiput. *Antennæ* black, a fine yellow line on the inner side of bases. *Front* greenish-yellow, a dull clouded brownish triangular area above in the centre, and a dark brown or dull black band (of varying width, according to the specimen) along the clypeal suture. *Clypeus* yellowish-grey, sutures tinged with brown. *Labrum* and *labium* grey; *genæ* pale greenish-yellow; mouth edged with brown. Thorax: *Prothorax* rather large, dark brown, a small yellow mark on the collar in front; a double small round dorsal spot, a larger spot on each side, and a small spot touching the procoxa on each side, all greenish-yellow. *Meso-* and *metathorax* rich brown above, a pair of fine slanting lines in front along the collar, behind these a pair of short antehumeral bars, somewhat slanting, and a pair of spots near the fore wing-joins; all these markings yellow more or less tinged with green. Also a very fine yellowish line along the dorsal ridge, only conspicuous for about 0·5 mm., where the ridge stands up into a small spine tipped with brown. The sides are of

various colours, as follows: firstly, the brown colour from above borders the sides in a band from forewing to mesocoxa; then comes an irregular greyish lateral band, enlarged near the wings, then suddenly constricted, and again enlarging into a rounded knob towards coxa; round this knob the rich brown from above curls, bending under it and more than half enclosing it. After this follows an irregular area of a beautiful mauve colour bordered with brown in the sutures; a greenish-yellow spot touches it near the hind wing-join, and a large spot of the same colour touches the metacoxa. Below the mauve area runs an irregular sublateral grey band similar to the former one, and, like it, nearly surrounded by a brown line or band in the sutures. Next to the abdomen is another, but smaller, area of mauve, touching the brown line on each side and shading into the sublateral band itself. Notum brown, scuta and scutella greenish-yellow. *Legs*: coxæ and trochanters dull yellowish-grey, femora dirty yellowish, much marked with brown lines and shaded with black, elbows yellowish, rest black. Abdomen fairly cylindrical, 1-2 swollen, 7-10 very slightly enlarged. Colour rich dark brown, shading to black, and marked with pale greenish-yellow as follows: 1, a small dorsal spot, a pair of large lateral spots; 2, a dorsal longitudinal band, rather narrow and irregular; spurs greenish-yellow above and below, ridged with a brown line; behind each spur a somewhat crescent-shaped spot; genital shield very large, yellowish-grey: 3, a round basal dorsal spot; bases greyish-yellow on sides; a pair of central dorsal spots very close and much pointed anally: 4-6, a broad transverse basal band, deeply cleft along dorsum, and a pair of central dorsal spots, narrow and elongated, and only separated by a fine line along the dorsum. This set of markings is such as to isolate a conspicuous brown spear-head mark on each segment. Low down on each side of 3-7 is an anal spot, largest in 7; 7 has the basal band and the central spots almost united, a fine transverse line only just separating them; 8, a pair of irregular basal dorsal marks almost united, and very often forming a single round spot, sides low down marked irregularly with yellowish,

often with two small anal spots; 9, very irregularly varied with yellow and brown both above and on the sides, the brown on the dorsum cleaving the yellow by a sharp point running up almost to the base; 10, yellow, shaded with brown in the suture. The markings of 7-10 are very irregular and varied, no two specimens being alike. Appendages: *Superior* about 1 mm., separated, divergent, subcornute, pale yellow, carrying underneath a large hook, brown tipped with black. *Inferior* wide apart, divergent, slightly upcurved, pale brownish, 0·3 mm.

♀ (unique). Differs from the male as follows:—A somewhat larger insect; pterostigma larger, orange-brown between black nervures. *Head* and *thorax* as in male. *Abdomen* slightly broader than in male, more cylindrical; 1-2 slightly swollen, 8-10 tapering. Scheme of markings as in male, but giving a very different effect, owing to the difference in the size of the markings. Ground colour almost black, appearing as if burnt to a reddish-brown in places. Yellow markings as follows:—1, a dorsal spot, and a large spot low down on each side; 2, an irregular longitudinal dorsal mark, shading to brown; a small yellow spot on each side; rest of sides mottled with brown and yellow: 3, a double basal dorsal spot, a pair of central dorsal spots just separated and pointed anally; basal half of sides yellow; a small lateral anal spot on each side: 4-7, the transverse basal band very broad on the sides, then narrowing above and cut into lobes by a fine dorsal line of brown; on 3-4 the central dorsal markings are present, but on 5-6 they are obsolete or almost so, a tinge of burnt sienna taking their places; on 7 they are present and close up to the basal band. All these segments have also a small round sublateral anal spot on each side; 8, a dorsal spot tinged with burnt sienna; sublateral parts yellowish; 9, as in the male; 10, brownish above, yellow on sides. *Appendages* straight, separate, 1 mm., somewhat pointed, yellow.

Hab.—Margaret River district; very rare. I took several males, but only one female. It is fond of settling on trees and bushes, and is not difficult to capture, though its flight is erratic and fairly fast.

This is a most remarkable species, with a coloration quite different from all known Austrogomphids, which are invariably black with bright yellow or greenish-yellow markings. There is no character in the wings which would warrant the formation of a new genus, though the shape of the abdomen, together with the remarkable colouring, might make one pause and consider the question. But the genus *Austrogomphus* is of itself artificial, and formed for the convenience of collecting together into one group all the Australian species of *Gomphus;* so that, until this genus is scientifically treated, this new species had better remain in it.

Subfamily ÆSCHNINÆ.

16. Hemianax papuensis Burm.

Common everywhere along the coast-line, rarer inland. It is found commonly all over Australia. A large insect, abdomen dull brown, mottled and marked all over with darker brown in intricate pattern. The forehead carries a thick black ᴛ-mark. Anal angle of hindwing of male rounded.

17. Æschna brevistyla Rambur.

Common all over the district. It is found nearly all over Australia, but is either absent or exceedingly rare in the tropical portion of the continent. It is a beautiful insect, of similar size and shape to the preceding, but the thorax is marked with light green bands, and the abdomen profusely spotted with green. In many specimens the markings are bluish, and in immature specimens they are pale, almost cream-coloured. The front carries the thick black ᴛ-mark, but the anal angle of the hindwing of the male is strongly angulated, a characteristic of all the *Æschnidæ* except *Hemianax* and *Anax.* Appendages of the male short.

18. Austroæschna anacantha, n.sp.

(Plate xxxv., figs.7-10; Plate xxxvi., fig.4.)

♂. Total length 63-67 mm., abdomen 49-52 mm.; forewing 40-44 mm., hindwing 39-43 mm.

Wings: *Neuration* black. *Pterostigma* 3·5 mm., narrow, black, covering 3-4 cellules. *Membranule*, fore small, hind about 2 mm., dirty whitish in young specimens, grey-brown or fuscous in the mature insect. *Nodal Indicator*

15-19	14-17
11-15	14-17

Head: *Occiput* carrying a small horn or tubercle, yellow. *Vertex* hairy, small, tubercled, black. *Antennæ* black, basal joint thickened. *Front* slightly hairy, black above, carrying two round yellow spots; lower part of front pale dirty brownish, shading to yellow next the eyes; a black transverse line in the suture bordering the postclypeus. *Postclypeus* dirty brown, black next anteclypeus; *anteclypeus* jet black, with a small brownish line next labrum, the middle of the line enlarged upwards into a sharp point. *Labrum* black with a pair of round brownish spots close together; *genæ* blackish with a round yellow spot; *labium* dull blackish, shading to brownish on mandibles and underneath. Thorax: *Prothorax* very small, black. *Meso-* and *metathorax* hairy, black, marked with pale dirty yellowish-brown spots as follows:—on each side of the dorsal ridge two small round antehumeral spots, also the interalar ridge is marked on each side by ill-defined elongated marks of olive-brown. On either side, a lateral row of 5 or 6 small irregular spots, and below these again two small spots, one on each side of the meta-spiracle; also a row of three small spots low down on the metathorax near the abdomen. Underside black with grey hairs. Notum black, a small yellowish spot on mesoscutellum; metanotum with grey hairs. *Legs* black, a brown spot at bases of tibiæ. Abdomen slender, 1-2 enlarged, 3 rather pinched. Colour black, marked with pale dirty brownish spots as follows: 1, all black, with grey hairs; 2, black, with some grey hairs on the dorsum, which carries either a conspicuous longitudinal mark or a fine line 2 mm. long; a pair of small basal spots; a pair of small central spots, very pointed and slanting, and a similar pair of anal spots: on each side an irregular elongated mark, skirting the top of the spur, the rest of which is black; also a smaller irregular anal spot; under the spur an elongated spot, followed by a smaller anal spot on the genital shield: 3-7, a pale elongated

basal spot or mark on each side of the dorsal ridge (on segment 3 these run down and spread over the underside); four small spots close together near the centre of the segment, formed by the supplementary carina cutting a pair of central spots transversely; a pair of very small anal spots, very often obsolete, on 5-7; on each side two small irregular spots, one basal and one anal, absent in 6-7; 8, a fine basal line in the suture on each side, a pair of dorsal spots one-third of the segment from the base; sometimes a dorsal anal spot; 9, a touch of pale brown on dorsal ridge, sometimes an anal dorsal spot; a lateral oval spot on each side; 10, sometimes a small spot at the base of each superior appendage; *no dorsal spine or tubercle.* Appendages: *Superior* wide apart, 4 mm., black, narrow sublanceolate, tips rounded; a tiny spine above the base of each, then a short stalk for about 1 mm., carrying underneath an obtuse spine, rest of appendages flat, with soft hairs on the inner margin. Viewed laterally, the inner margin is seen to bend down, forming an obtuse-angled projection underneath. *Inferior* short, 1·8 mm., thick, black, somewhat truncated, with the tip 0·5 mm. broad and slightly bifid; hollow above, slightly upcurved at tip, very rounded and convex beneath.

♀. Differs from male as follows:—Pterostigma brownish. Dorsal spots of thorax exceedingly small. *Abdomen* much thicker than in male, 1-2 swollen, 7-10 slightly enlarged. General scheme of markings similar to male, but some of the dorsal spots on 2 either very indistinct or entirely absent; basal marks of 3-7 very small, and anal spots generally quite absent; lateral spots much larger than in male, the basal ones half cut into on 3-5 by a short black hook or intrusion; 8, rather short, black; on each side a tiny basal spot low down, also an anal spot; ovipositor black, large, carrying two fine filaments nearly 2 mm long, with their basal joints thickened; 9, black, with a pair of anal spots; 10, black, carrying beneath the appendages a rounded black hairy tubercle, and beneath this again a small ridge armed with four or five small teeth. *Appendages* very short, slightly separated, 0·8 mm., very flat; rather wide at bases, black, tips blunt and rounded.

Hab.—Mountain-brooks, Armadale, Waroona, Bridgetown; exceedingly abundant at Wilgarrup and Margaret River; December-February.

This fine but very black-looking insect is a splendid flyer, skimming swiftly over the running streams, or dodging in and out of the overhanging herbage at great speed. Sometimes they will hover almost motionless over a pool for a long time or travel slowly up and down in search of prey. On hot summer days they may be seen dashing about at great speed in almost bewildering succession, especially towards evening. This species, to which I have given the name *anacantha* because of the absence of the large dorsal spike on segment 10 of the male, is very closely allied to *A. parvistigma* and *A. multipunctata* of the Eastern States. The males may be at once distinguished by the absence of the spine referred to, and both sexes by the comparative minuteness of the spots on the thorax and abdomen. In the evenings it settles in the dried undergrowth of the "black-boys," or sometimes on the trunks, or on the trunks of trees and bushes; and in such a position its protective colouring renders it exceedingly difficult to discover. It is easily disturbed, and dashes off at lightning speed. It is not easy to capture.

Family CALOPTERYGIDÆ.

None.

Family AGRIONIDÆ.

19. Argiolestes minimus, n.sp.

(Plate xxxv., figs.11-12.)

♂. Very variable in size, the commonest form being:—total length 32-34 mm., abdomen 26-27 mm., forewing 21 mm., hindwing 20 mm.

Wings: *Neuration* black. *Pterostigma* 1·3, white in the young insect, but gradually darkening to brown or even black in the mature insect. *Nodal Indicator* $\left\| \begin{matrix} 2 & 9\text{-}14 \\ 2 & 9\text{-}12 \end{matrix} \right|$. Head: *Eyes* black; *epicranium* black, shading to dull grey near eyes and postclypeus; *postclypeus* dark grey; *anteclypeus* black,

with a white line edging the labrum; *labrum* black, *genæ* pale dull yellowish, *labium* black, shading to pale brown below. Thorax: *Prothorax* black. *Meso-* and *metathorax* dark metallic green (black in the aged insect), lower parts of sides and underside brownish, with two slanting black spots close to coxæ. *Legs* slender, black, coxæ pale. Abdomen: slender, cylindrical, 1-2 and 7-10 slightly enlarged. Colour very dark metallic-green throughout (black in the aged insect); a fine white transverse line in the anal suture of 8, a broad one in the anal suture of 9, a tiny white V at the end of 10. On each side a tiny white mark in the anal suture of 2-5. Appendages: *Superior* forcipate, thin, 1 mm., black; a small spine on the inner margin near the tip, and 3 or 4 minute spines and hairs on the outer margin. *Inferior* very short, black, wide apart, upcurved, tips blunt.

♀. Total length 29-31 mm., abdomen 24-25 mm. It differs from the male as follows:—*Eyes* pale milky-blue behind, black in front, epicranium milky-white in front along the orbits. *Abdomen* cylindrical, stouter and shorter than in the male, seen sideways 8-10 much enlarged; 8 has a pale cream-coloured transverse band next the suture, nearly half a millimetre broad in the middle. Ovipositor black and projecting beyond appendages. *Appendages* very short, black, cylindrical, slightly separated.

Race *pusillus*.—An extremely small race found in the southern districts, and differing considerably from the type. Were it not for the fact that intermediate forms are commonly found, connecting this with the type, one would certainly see in them two distinct species. The differences are as follows:—

♂. Total length 27 mm., abdomen 21 mm.; forewing 15 mm., hindwing nearly 16 mm. *Pterostigma* rather narrow, 0·7 mm., black; *forewings shorter than hindwings.* *Legs* rich brown or reddish-brown. Anteclypeus pale brownish-yellow. Thorax and first two segments of abdomen slightly powdered with greyish bloom, groundcolour deep black. Appendages with the spine on inner margin very conspicuous.

♀. Similar to male, but of stouter build. Eyes brownish; notum touched with brown; abdomen fairly stout, cylindrical, black with a slight tinge of metallic green. Ovipositor projecting further beyond appendages than in the type.

Hab.—Common on all the mountain-brooks; rare on the larger rivers and coastal lagoons. Race *pusillus* occurs, together with the type-form and intermediate forms, at Bridgetown, Wilgarrup, and probably in many other localities. It also occurs at Albany; all the specimens in the Macleay Museum, Sydney, from Albany, are of the race *pusillus*.

It is generally found sitting about with outspread wings on the stems of grass and reeds overhanging running streams. Often several specimens could be netted at once by a sweep of the reed-clumps. Its flight is weak and slow, and it is easily captured, even with the hand. The race *pusillus* often sits with its wings closed, a peculiarity shared by *A. griseus*, which is sometimes found in that position.

It appears to me that *pusillus* holds very much the same relation to the type *minimus* as *griseus* does to *icteromelas*. But in the case of the two common Eastern species the intermediate forms are absent, and the two species easily separated, though in some districts rather small forms of *icteromelas* occur. In *pusillus* we have *a species in course of formation*. Put *pusillus* and *minimus* side by side, and one sees two absolutely distinct species. But take two dozen of the insects from any one locality, and they can be arranged so as to link together, gradually and almost insensibly, the two extreme forms. The type-form *minimus* can be easily distinguished from *A. griseus* of the Eastern States, to which it is closely allied, by its smaller size, more slender build, the lack of thoracic markings, the shape of the appendages, which are much slenderer, and the lack of grey bloom on the abdomen. The race *pusillus* approaches *griseus* closely in having grey bloom on the thorax and part of abdomen, but it is less than half the size of *griseus*, and differs from it in other respects as the type does.

20. Lestes analis Rambur.

Common everywhere. It is also found very abundantly in S. Australia and Victoria, and fairly commonly in New South Wales. A very variable insect, both in size and colouring, the markings generally being pinkish, but pale blue in very mature specimens. On the mountain-brooks at Armadale and Waroona, a dwarf form occurs with dull greyish markings.

21. Lestes annulosus Selys.

Fairly common at Mungar's Lake, Perth; a few specimens also at Bridgetown. It is also found in South Australia and in the western parts of Victoria. A most beautiful species, dark bronze with light blue stripes on thorax and rings on abdomen, the dorsal surface appearing to have a series of dark bronze arrow-heads along a blue ground. Female duller, with less blue. Males much commoner than the females.

22. Lestes io Selys.

Widely distributed, but local and rather rare. Two males at Wilgarrup, one female at Bridgetown, one at Armadale; fairly common at Margaret River, but requires searching for. A rather small species with very slender abdomen, bronze with narrow blue rings; wings narrow and rather pointed.

23. Lestes psyche Selys.

Somewhat commoner than the preceding. Several at Mungar's Lake, Perth; two at Armadale; fairly common at Margaret River. Very similar to the preceding species, but with shorter abdomen, and wider and more rounded wings. Also occurs sparingly in New South Wales.

These two species are at first sight exceedingly alike, but may be distinguished as follows:—In the male, the second segment of the abdomen of *L. io* is dark bronze, or black, *without markings* on the dorsal surface, while in *L. psyche* it is more or less blue, the blue from the sides of the segment intruding and cutting

out the black centrally, leaving a more or less clepsydrate black or bronze dorsal mark. The thoracic stripes are slightly different in shape; the abdomen of *L. io* narrower but larger than that of *L. psyche*. The females are exceedingly similar in shape and markings, and are best separated by the shape of the wings, which are narrower and much more pointed in *L. io* than in *L. psyche*.

24. ISCHNURA DELICATA Selys.

Common in all marshy localities and on the lagoons, rarer on the large mountain-streams. At Wilgarrup every patch of long grass or sedge in the marshes yielded hundreds; and it was a beautiful sight to see the swarms of males like brilliant red needles tipped with blue, hovering over the grass after being disturbed. This is one of the smallest known dragonflies, and also one of the most beautiful. The abdomen of the male is very slender, bright red tipped with light blue and a little black. The ordinary female is either dull black or olive-green. At Bridgetown and Wilgarrup I found a remarkable dimorphic female, which imitates the colouring of the male. [See These Proceedings, p. 190, "On Dimorphism in the Females of Australian Agrionidæ."] The proportion of dimorphs to ordinary females was about 10%. This insect is abundant over the whole of Australia, even in the dry central districts and in the tropics; the northern forms are exceedingly small. The dimorphic female has not been found outside of Western Australia.

24. PSEUDAGRION CŒRULEUM, n.sp.

(Plate xxxv. figs. 13-14).

♂. Total length 27 mm.; abdomen 22 mm.; forewing 14·5 mm., hindwing 14 mm.

W i n g s : *Neuration* slender, black. *Pterostigma* 0·6 mm., black. *Nodal Indicator* $\left\|\begin{matrix}2 & 7\text{-}9\\ 2 & 6\text{-}7\end{matrix}\right|$ H e a d : *Eyes* dark blue, black behind. *Epicranium* hairy, black, a brilliant blue wavy transverse band behind, reaching from eye to eye, and very slightly enlarged at the ends; front ocellus transparent; two tiny

blue spots at bases of ocelli; in front a dull greenish-blue area carrying a small black flattened ᴛ-mark, the base of which proceeds from under the front ocellus. *Postclypeus* hairy, black; *anteclypeus* blue; *labrum* blue with a tiny black spot. *Orbits* blue inwards, with a small black spot near the epicranium. *Labium* pale dirty brown. Thorax: *Prothorax* black, a narrow blue collar in front, a small blue spot on each side. *Meso-* and *metathorax* brilliant blue, a broad metallic dorsal black band, and on each side a narrower lateral black band; some black in the sublateral suture; underside dirty brown. *Legs* blackish above, pale beneath. Abdomen: 1-2 slightly enlarged, 7-10 swollen. Colour: 1, blue with a black basal spot; 2, brilliant blue, a large cup-shaped dorsal blotch of black, and an anal black band in the suture: 3, basal three-fourths brilliant blue, rest black, the black running up into a point along the dorsum; 4-6, metallic bronzy-black, with a bright blue basal band, which extends underneath along the sides nearly the whole length of each segment; 7, basal three-fourths black, rest blue, basal sutures blackish; 8-9 bright blue, blackish in the sutures; 10 black. Appendages: *Superior* very short, separated, black, a stiff hair near the tips on the inner margin. *Inferior* minute.

♀. Differs from the male as fellows: *Head*: Postocular band *dull* blue; other parts which are blue in male are grey in female. *Thorax* as in the male. *Abdomen* cylindrical, thicker than in the male. Colour: 1, blue, with a dorsal black spot; 2, a large irregular black dorsal patch; sides blue; 3-6, metallic bronzy-black above, with blue sides and a narrow transverse basal blue band; the black dorsal area is somewhat narrowed for four-fifths of the segment, then slightly notched, and finally enlarged at the anal end into a rounded patch covering *all* the dorsal portion and a little of the lateral besides; 7, black above, blue on sides; a transverse basal blue line; 8, black above, with a basal transverse blue line; a blue line in the anal suture, and close up to it on either side a small round blue spot; 9-10, black, sutures blue. Underside greyish. Ovipositor carries two very short black filaments. *Appendages* very short, wide apart, conical, black.

Hab.—Common at Mungar's Lake, Perth; rather rare at Armadale, Bridgetown, Wilgarrup and Margaret River. A very beautiful and conspicuous little insect. It flies close to the water and is fond of settling on floating leaves of water-plants, or on stems of grass or reeds.

This species is very closely allied to *P. cyane* Selys, of the eastern States. The males can be at once distinguished by the greater amount of blue on the abdomen of *P. cœruleum*; in particular, segments 3 and 7-9; *P. cyane* has only a narrow band of blue on 3, *no blue on 7*, and some black at the anal end of 9. The females are absolutely different; that of *P. cyane* being dark bronzy-black with pale olive-green markings.

26. Xanthagrion erythroneurum Selys.

Common at Mungar's Lake, Perth. I did not find it in any other locality. It is widely distributed over Australia, local, but generally abundant where it occurs. It is a beautiful insect with deep brick-red thorax; base of abdomen red, rest metallic bronzy-black tipped with blue. Female considerably duller. It is probably confined to the coastal lagoons.

EXPLANATION OF PLATES XXXIV.-XXXVI.

Plate xxxiv.

Map of South-Western Australia.

Railways

Isohyetals .... 35″

Plate xxxv.

Fig. 1.—*Synthemis Martini*, n.sp.; ♂ appendages, dorsal view.
Fig. 2.— ,, ,, ,, lateral view.
Fig. 3.—*Synthemis cyanitincta*, n.sp.; ♂ appendages, dorsal view.
Fig. 4.— ,, ,, ,, lateral view.
Fig. 5.—*Austrogomphus occidentalis*, n.sp.; ♂ appendages, dorsal view.
Fig. 6.— ,, ,, ,, lateral view.
Fig. 7.—*Austroœschna anacantha*, n.sp.; ♂ appendages, dorsal view.
Fig. 8.— ,, ,, ,, lateral view.

Fig. 9.—*Austroæschna anacantha*, n.sp.; ♀ appendages, dorsal view.
Fig. 10.— „ „ „ lateral view.
Fig. 11.—*Argiolestes minima*, n.sp.; ♂ appendages, dorsal view.
Fig. 12.— „ „ ♀ appendages, lateral view.
Fig. 13.—*Pseudagrion cæruleum*, n.sp.; ♂ appendages, dorsal view.
Fig. 14.— „ „ ♀ appendages, lateral view.

Plate xxxvi.

Fig. 1.—*Synthemis cyanitincta*, n.sp. ♂.
Fig. 2.—*Synthemis Martini*, n.sp. ♂.
Fig. 3.—*Austrogomphus occidentalis*, n.sp. ♂.
Fig. 4.—*Austroæschna anacantha*, n.sp. ♂.

WEDNESDAY, OCTOBER 30TH 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, October 28th, 1907.

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

The President referred to the death of Alfred Stapleton on 28th instant, at the age of 76, and of his worthy wife on 26th August. Mr. Stapleton had been uninterruptedly in the service of some member of the Macleay family or of the Society for about half a century, and had had charge of the Society's premises ever since the liberality of Sir William Macleay had provided it with a permanent home. The Secretary bore testimony to the civility, trustworthiness, and exemplary devotion to duty displayed by Mr. and Mrs. Stapleton; and, on the motion of Mr. T. Steel, it was resolved that a record of the Society's appreciation of their long and faithful service should be inscribed in the Minutes.

The President announced that the Council was prepared to receive applications for three Linnean Macleay Fellowships, tenable for one year from April 1st, 1908, from qualified Candidates. Applications should be in the hands of the Secretary on or before 30th November, 1907. In the meantime intending Candidates were recommended to put themselves in communication with the Secretary, who would afford all necessary information.

Attention was also called to a proposal to establish an association for the study of aquatic life, and to the inaugural meeting of those interested in aquaria, to be held in the Girls' High School, Castlereagh Street, on Monday, 18th November, at 8 o'clock.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 10 Vols., 58 Parts or Nos., 13 Bulletins, 5 Reports, 3 Pamphlets, received from 43 Societies, &c., and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. David G. Stead exhibited a well preserved example of the curious so-called "Beaked Salmon," *Gonorhynchus gonorhynchus* (Linné) which has usually been looked upon as one of the rarest members of the New South Wales fish fauna, and which was recorded from these waters for the first time, by Ogilby, in the Society's Proceedings for 1899(p.154). Specimens from the following localities on the coast of New South Wales had been examined: Tuggerah Lakes (two records); Port Jackson; Botany Bay; Como, George's River; Wollongong; Lake Illawarra (two records); from the mouth of a snapper captured 3 miles east of Greenwell Point Lighthouse (this was a young specimen and is a very interesting record); Conjola Lake. In the case of the second record at Lake Illawarra (June, 1906) many specimens, aggregating about half a basket, were captured in one haul.

Dr. Greig-Smith gave an interesting résumé of his impressions and experiences on visiting a number of the more important bacteriological laboratories and institutions of the United Kingdom and on the Continent during a recent tour in Europe.

Mr. Fletcher exhibited flowers of *Jasminum grandiflorum* Linn., from the Society's garden, almost every one of them affording an instance of median floral prolification ("hose in hose"). The continued dry weather at present prevailing was, perhaps, a stimulus to the production of abnormal flowers. Similar occurrences had not been noticed in previous years.

ON THE TERTIARY LIMESTONES AND FORAMINIFERAL TUFFS OF MALEKULA, NEW HEBRIDES.

By Frederick Chapman, A.L.S., F.R.M.S., National Museum, Melbourne.

(Plates xxxvii.-xli.)

CONTENTS.

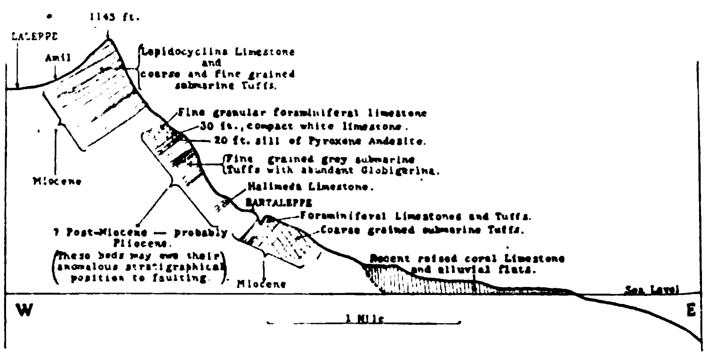
i. Introduction.

The series of rocks from Malekula now under discussion, form part of the extensive and valuable collection made by Mr. Douglas Mawson, B.Sc., B.E., in 1903. The present paper, in continuation of one I have already published,* and another con-

* "Notes on the Older Tertiary Foraminiferal Rocks on the West Coast of Santo, New Hebrides," Proc. Linn. Soc. N. S. Wales, 1905, Vol. xxx. pp.261-274, pls.v.-viii.

jointly with Mr. Mawson,* deals exclusively with the Miocene and the post-Miocene (probably Pliocene) rocks of the Island of Malekula, south of Santo; and although the specimens comprised in this part of the collection are not numerous, this is amply compensated for by their extremely interesting nature.

The following outline sketch, kindly drawn up by Mr. Mawson, illustrates the field-relations of the beds herein dealt with.



Compare with that appearing in "The Geology of the New Hebrides,"† in which the series above Bartaleppe, now regarded as probably Pliocene, is not differentiated from the Lepidocyclina series, and is regarded as Miocene.

ii. The Miocene Limestones and Tuffs.

Details of the specimens examined:—

No.105.—"Limestone *in situ* at Amil, Laleppe (Lalemba) N. end of Malekula. At least 1000 ft. above sea-level "‡

* "Halimeda Limestones of the New Hebrides," Quart. Journ. Geol. Soc. Vol. lxii. 1906, pp.702-711, pls.xlix.-li.

† Proc. Linn. Soc. N. S. Wales, 1905, Vol. xxx. p.417, fig.2.

‡ Mawson, *op. cit.* p.418.

This is a whitish or cream-coloured limestone, of fairly compact texture, and having the appearance of a hard coral-reef rock, with occasional fragments of decomposed volcanic rock (andesite) showing on the fractured surface.

Subjected to a microscopic examination, this rock is seen to consist of numerous tests of foraminifera, both large and small, the former being usually fragmentary, or showing signs of abrasion before being cemented into the rock. The matrix consists of a fine granular paste, and its earthy or chalky appearance in thin sections leads one to conclude that calcareous algæ, although no longer apparent in the rock, played an important part in its original constitution. Besides foraminifera, the following organic remains were seen :—*Lithothamnium* (*L. ramosissimum* Reuss sp.) and probably *Lithophyllum* (growing in a thin foliaceous manner and encrusting other organisms); numerous echinoid spines; also polyzoa.

The Foraminifera observed in this rock are :—

Orbulina universa D'Orb. Section showing the initial 'globigerine' series of chambers.

Truncatulina sp.

Carpenteria rhaphidodendron Moebius.

Pulvinulina cf. *repanda* F. & M. sp.

Gypsina globulus Reuss sp.

Miogypsina burdigalensis Gümbel sp.

Polytrema planum Carter. Growing in alternate layers with (?) *Lithophyllum*.

Amphistegina lessonii d'Orb. Very large specimens with numerous whorls, probably the microspheric form of the species.

Operculina sp. In fragments only.

Lepidocyclina angularis Newton & Holland.

L. andrewsiana Jones & Chapman.

L. verbeeki Newton & Holland.

Nos. 106A and 106B.—"Fragments of rock *in situ* (limestones and tuffs), at creek just before Bartaleppe (about 400 ft. above sea-level), Malekula."*

No. 106A is a whitish, granular, and somewhat friable limestone, rather tuffaceous, with embedded pellets of igneous rocks. In thin sections this limestone is seen to consist largely of foraminiferal tests, but branching *Lithothamnium*, echinoid fragments, and lamellibranch shells are also present.

The Foraminifera are:—

Globigerina conglobata Brady.
Truncatulina sp.
Carpenteria rhaphidodendron Moebius sp.
Rotalia sp.
Amphistegina lessonii d'Orb.; large tests as in No. 105.
Operculina sp.
Linderina cf. *brugesi* Schlumberger.
Lepidocyclina (?) *verbeeki* Newton & Holland.
L. (?) *sumatrensis* Brady.

No. 106B.—An ash-coloured, fine-grained, friable tuff, containing a large number of *Globigerina* tests, referable to *G. bulloides* d'Orb., and *G. conglobata* Brady.

No. 108.—"From the Laleppe Amil to Bartaleppe track, about 1 mile from the amil, and at an elevation approximating 1000 ft."* A compact yellowish limestone. The matrix of the rock is fine-grained, with a crystalline cement. Distributed throughout are large foraminiferal tests, chiefly of *Lepidocyclina*, *Operculina*, and *Miogypsina*. Associated with these organisms are fragments of the characteristic *Lithothamnium ramosissimum* and echinoid plates and spines. The Foraminifera in this rock are of especial interest, as the following list will show:—

Spiroloculina cf. *limbata* d'Orb.
Miliolina cf. *trigonula* Lam. sp.

* Mawson, *op. cit.* p. 418.

Miliolina cf. *tricarinata* d'Orb. sp.

Sigmoïlina sp.

Trillina howchini Schlumberger; very common. (Pl. xxxix., figs.7-9).

Alveolina cucumoides, sp.nov.; very common. (Pl. xxxviii., figs.5, 6).

Truncatulina sp.

Carpenteria sp.

Gypsina globulus Reuss sp.

Miogypsina complanata Schlumberger; frequent.

Operculina complanata Defr.; very common. (Pl. xxxvii., figs.1, 2; Pl.xxxviii., fig.3).

Lepidocyclina cf. *andrewsiana*, Jones & Chapman; rare.

L. angularis Newton & Holland; common. (Pl.xxxvii., fig.2; Pl. xxxviii., fig.4).

L. verbeeki Newton & Holland; frequent.

L. munieri Lemoine & R. Douvillé; very rare. (Pl.xxxvii., fig.2).

iii. Limestones and Tuffs of (?) Post-Miocene Age.

Details of specimens :—

No.87.—" Limestone several hundred feet above sea-level, Port Stanley, Malekula."†

General characters: a hard cream-coloured limestone, with whitish streaks and patches, due to partially decomposed organic structures, in consequence of which the rock is rendered powdery and cavernous, and difficult to preserve whole in thin sections.

Microscopical characters: a study of this rock under the microscope shows it to be largely of foraminiferal origin, possibly more than 50% of the rock consisting of their tests. This example is rather of the nature of a reef-rock than a consolidated beach sand, and it is also distinctly brecciated. The larger organisms, as for example the reef-forming foraminiferon, *Polytrema planum*, are frequently broken, the latter being

† Mawson, *op. cit.* p.416.

often faulted across its plane of growth or attachment-surface, as if the onslaught of talus-blocks had disturbed a half consolidated reef-accumulation, shattering the thin cake-like organic overgrowths. The ground-mass of the rock consists of a fine, crystalline, calcitic mud. Amongst the amorphous-looking brecciated fragments there appear to be traces of coral structure.

The Foraminifera seen in this limestone in the order of their abundance are :—

Polytrema planum Carter. One specimen measures about 10 mm. in length. (Pl. xl., fig. 11).

Amphistegina lessonii d'Orb.

Heterostegina depressa d'Orb. Examples with a thick central disc.

Carpenteria sp.

Rotalia sp.

Truncatulina sp.

? *Textularia*.

The other organic remains present in this rock are polyzoa, echinoid spines and a thin, encrusting (?) calcareous alga.

No. 88.—"Limestone from hill above Port Stanley, near sea-level."

General characters: a cream-coloured brecciated limestone, in all probability originally entirely organic, but subsequently suffering a certain amount of decomposition and disintegration, resulting in its present granular structure. The chief organic constituents are calcareous algæ, represented by the branching *Lithothamnium*, *L. ramosissimum*, and molluscan shells, chiefly gasteropods, and a plate of an echinid test.

The only Foraminifera noticed are :—

Miliolina bosciana d'Orb. sp.

? *Verneuilina pygmæa* Egger.

? *Carpenteria*.

Gypsina ? *globulus* Reuss sp.

Amphistegina lessonii d'Orb.

(?) Pliocene or subrecent in age.

No.91.—"Chips from seats in Amil, Pinalum Point, on E. Coast, Malekula (not *in situ*)."*

91A.—Macroscopic characters: a hard, yellowish, gritty-looking limestone of fine-grained texture.

Microscopic details: in thin sections this is seen to be an impure limestone of organic origin, containing abundant foraminifera, a few fragments of a slender, branching *Lithothamnium*, some polyzoa, and lamellibranch shells, together with a fair amount of angular quartz and a few scattered particles of hornblende and a chloritic mineral. A coarsely crystalline calcitic cement surrounds the rock-constituents, and the whole texture is granular. The Foraminifera are excellently preserved, and include—

Globigerina bulloides d'Orb.; rare.
G. conglobata Brady; common.
? *Pullenia obliquiloculata* P. & J.; frequent.
Sphæroidina dehiscens P. & J.; frequent. (Pl. xli., fig.14).
Truncatulina cf. *ungeriana* d'Orb. sp.
Pulvinulina ? *repanda* F. & M. sp.; rare.
Amphistegina lessonii d'Orb.; common.
Heterostegina sp.

91B.—Macroscopic characters: a compact yellow to ash-coloured limestone, containing numerous lighter-coloured streaks and patches, chiefly the remains of calcareous plants.

Microscopic contents: under the microscope this rock is seen to consist largely of the sea-weed *Halimeda*. Foraminifera, echinoid fragments, and polyzoa are also present, the whole being cemented by a clear crystalline deposit of calcite. The Foraminifera noticed are:—

Miliolina sp.
Sigmoïlina sp.
Orbitolites complanata Lamarck.

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* Mawson, *op. cit.* p.416, where they are classed as Miocene.

Orbitolites marginalis Lam. sp.

Textularia trochus d'Orb. (Pl. xli., fig. 15).

Carpenteria sp.

Pulvinulina sp.

Heterostegina depressa d'Orb.

The age of these rocks is probably Pliocene or later. The foraminiferon *Sphæroidina dehiscens*, which occurs in 91A with frequency, has not been found in strata below the Pliocene (*fide* H. B. Brady).

No. 102.—"Outcrops at Laleppe, about 900 ft. above sea-level, Malekula."*

This is a rather gritty, pale ash-coloured limestone, principally organic, but with an admixture of volcanic products, chiefly glassy. Besides foraminifera, spines of echinoids were noticed in thin slices of this rock.

The Foraminifera are :—

Biloculina cf. *ringens* Lam.

Orbulina universa d'Orb.; frequently showing the enclosed embryonic 'globigerine' stage of the test. (Pl. xli, fig. 13).

Globigerina bulloides d'Orb.

G. conglobata Brady.

Carpenteria sp.; tests much crushed.

Pulvinulina cf. *repanda* F. & M. sp.

Amphistegina lessonii d'Orb.; specimens numerous but small. (Pl. xli., fig. 13).

Heterostegina depressa d'Orb.; tests fragmentary, common.

Probably of Pliocene age.

No. 107.—"Bedded sedimentary series on the Laleppe Amil to Bartaleppe track at an elevation of about 700 ft.; Malekula."*

Fine-grained, ash-coloured, foraminiferal tuffs.

Globigerina numerous. Specimens apparently all belonging to *G. bulloides* d'Orb.

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* Mawson, *op. cit.* p. 418.

iv. Distribution List of Foraminifera from Malekula.

NAME.	MIOCENE.				POST MIOCENE.					
	105	106A	106B	108	87	88	91A	91B	102	107
Biloculina cf. *ringens* Lam.									×	
Spiroculina cf. *limbata* d'Orb				×						
Miliolina cf. *trigonula* Lam. sp.....				×						
,, cf. *tricarinata* d'Orb. sp.				×						
,, sp..........................								×		
Sigmoïlina sp.				×				×		
Trillina howchini Schlumberger...				×						
Orbitolites complanata Lam....... ...								×		
,, *marginalis* Lam. sp.....								×		
Alveolina cucumoides, sp. nov........				×						
Textularia trochus d'Orb......... ...								×		
? *Textularia*............................					×					
? *Verneuilina pygmæa* Egger........						×				
Orbulina universa d'Orb.............	×								×	
Globigerina bulloides d'Orb..........			×				×		×	×
,, *conglobata* Brady..... ..		×	×				×		×	
? *Pullenia obliquiloculata* P. & J..							×			
Sphæroidina dehiscens P. & J... ...							×			
Truncatulina cf *ungeriana* d'Orb. sp.							×			
,, sp..	×	×		×	×					
Carpenteria rhaphidodendron Moeb	×	×								
,, sp....................				×	×	? ×		×	×	
Gypsina globulus Reuss sp...........	×			×		? ×				
Miogypsina burdigalensis Gümbel sp	×									
,, *complanata* Schlumberger				×						
Polytrema planum Carter............	×				×					
Pulvinulina cf. *repanda* F. & M. sp	×						×		×	
,, sp..........................								×		
Rotalia sp.......		×			×					
Amphistegina lessonii d'Orb........ ..	×	×			×	×	×		×	
Operculina complanata Defr....... .				×						
,, sp.	×	×								
Heterostegina depressa d'Orb					×			×	×	
,, sp................							×			
Linderina cf. *brugesi* Schlum.......		×								
Lepidocyclina angularis New. & Holl.	×			×						
,, *andrewsiana* Jones & Chapm.	×			? ×						
,, ? *sumatrensis* Brady...		×								
,, *munieri* Lemoine & Douville				×						
,, *verbeeki* Newton & Holland	×	? ×		×						

v. Notes on the New Species and more Remarkable Forms.

Trillina howchini Schlumberger. (Plate xxxix., figs. 7-9).

Trillina howchini Schlumberger, 1893, Bull. Soc. Géol. France, ser. 3, Vol. xxi. p. 119, woodcut fig. 1, and pl. iii. fig. 6.

The interesting genus *Trillina* contains only one species so far as known, which was first described in detail by M. Schlumberger under the name of *T. howchini*. It was previously discovered by the Rev. W. Howchin, who had identified it with *Quinqueloculina prisca* Terquem.* The specimens were originally found by Mr. Howchin in the lower beds† of Muddy Creek, near Hamilton, Victoria; they are there "moderately common." The same species has been recorded by Schlumberger as occurring very commonly in the Isle of Zebu in the East Indian Archipelago,‡ together with a species of *Sigmoïlina*. It is noteworthy that the latter genus is similarly present in association with *Trillina* in one of the limestones from Malekula.

Trillina howchini occurs only in one sample of limestone in our series, namely that from Bartaleppe, Malekula (No.105). It is an abundant form, and easily recognisable in thin sections of the rock. Although isolated specimens were not obtained, the characters of the variously orientated sections of the tests are in every way identifiable with the clearly described and illustrated species established by Schlumberger. Both the megalospheric and microspheric forms appear to be here represented. The associated genera in this limestone are *Spiroloculina*, *Miliolina*, *Sigmoïlina*, *Alveolina*, *Truncatulina*, *Carpenteria*, *Gypsina*, *Miogypsina*, *Operculina*, and *Lepidocyclina*.

ALVEOLINA CUCUMOIDES, sp.nov. (Plate xxxviii., figs.5-6).

Alveolina sp. Verbeek, 1896, Descr. Géologique de Java et Madoura, Vol.i. p.1142, pl.ii. fig.43.

Description.—Test elongately fusiform; thickest in the middle, more or less constricted on either side, and tapering to a blunt point at either end. The convolutions number 8 or 9 in the adult shells. Chambers ovoid, the outer roof slightly arched.

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* Trans. Roy. Soc. S. Australia, Vol.xii. 1889, p.2.

† Not the upper beds, as stated by Schlumberger, *loc. cit.* p.120.

‡ *Loc. cit.* p.123.

All the specimens, so far as seen, commence with a small initial chamber (*i.e.*, they are microspheric). Length of a typical specimen 2 mm.; thickness at centre 0·72 mm. Another example measures 1 mm. in diameter.

Occurrence.—Very abundant in limestone from Bartaleppe, Malekula (No. 108).

Observations.—There is little or no doubt that Verbeek's *Alveolina*, which he found in the Lower Miocene limestone in the Palabouhan District of Java, is the same as our species from Malekula which I now name *A. cucumoides*. Verbeek gives as the dimensions of the Javan examples, length 3·50 mm., thickness 0·75 mm., and the number of spiral turns as 6 to 7. He also states that the central chamber was not clearly seen in his preparations.

The above species differs markedly from *Alveolina elongata* d'Orbigny (= *A. frumentiformis* Schwager),* a species from the Middle and Upper Eocene, in its irregular contour, since it is not evenly cylindrico-fusiform as in Schwager's species, but is constricted on either side of the median axis; otherwise the shape and disposition of the chambers, and the structure of the test are very similar. It is especially interesting to meet with *Alveolina* in its microspheric stage, since all recorded recent forms have hitherto only been represented by the megalospheric type of shell. Schlumberger gives a single instance,† discovered by Munier-Chalmas, in which the microspheric form occurred in a fossil species. With regard to a recent species of the genus, *Alveolina boscii* Defr., I have lately met with some examples which also show this unusual condition. They are from the Great Barrier Reef of Queensland, in material obtained through the courtesy of Messrs. C. Hedley and J. Gabriel. The specimens are, however, very rare compared with the associated megalospheric form.

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* Palæontographica, Vol. xxx. 1883, p. 100, pl. xxv., figs. 4*a*-*i*.

† Assoc. Franç. Avan. Sci., Congrès de Rouen, 1883, p. 526.

POLYTREMA PLANUM Carter. (Plate xl., fig.11).

This encrusting foraminifer, so common as a reef-former at the present day, has already occurred in the fossil condition in the Miocene limestones of Wai Malikoliko and Wai Bubo, Santo, New Hebrides.* It now occurs in the Miocene limestone at Laleppe, Malekula, associated in its characteristic way of laminar intergrowth with a calcareous alga; and also in the Post-Miocene limestone of Port Stanley, Malekula, where it also played an important part in building up the rock.

LINDERINA cf. BRUGESI Schlumberger.

Linderina brugesi Schlumberger, 1893, Bull. Soc. Géol. France, ser.3, Vol.xxi. pl.iii. fig.9.

Our specimens occur in the friable limestone from Bartaleppe, Malekula, and there is very little doubt that they belong to Schlumberger's species. In median section *Linderina* can be separated from *Gypsina* by the continuous nature of the chamberlet-wall in the former, whereas in the latter the cells are entirely cut off from one another, excepting for the mural perforations.

A species of *Linderina* from the Miocene limestone of Borneo has already been recorded and figured by Newton & Holland,† and a more doubtful occurrence of the genus was noted from Riū-Kiū Island by the same authors.‡ Schlumberger's origina specimen of *L. brugesi* came from the Upper Eocene of Bruges, Gironde.

LEPIDOCYCLINA ANGULARIS Newton & Holland. (Plate xxxviii., fig.3).

L. angularis Newton & Holland, 1902, Journ. Coll. Sci. Tokyo, Vol.xvii. Art.6, p.10, pl.i. figs.1-6; pl.iii. fig.7.

This species is characterised by its depressed central area, the outer boundary of which is marked by strong calcified pillars,

* Proc. Linn. Soc. N. S. Wales, 1905, p.270, pl.v., fig.2.
† Ann. Mag. Nat. Hist. Ser.vii. Vol.iii. 1899, p.262, pl.x., fig.6.
‡ Journ. Coll. Sci. Tokyo, Vol.xvii. Art.6, 1902, p.15, pl.i., fig.2.

which emerge at the surface in large rounded bosses. Another feature of this species is the expansion of the median layer towards the edge of the test. Previously described only from Iriomoté Island, Riū-Kiū (Loo Choo Islands).

We have a fine series of this interesting *Lepidocyclina* in the sections of the Malekula Miocene limestones. It occurs both at Laleppe and Bartaleppe.

LEPIDOCYCLINA MUNIERI Lemoine & R. Douvillé. (Pl.xxxvii.,fig.2).

L. munieri Lemoine & R. Douvillé, 1904, Mem. Soc. Géol. France, p.20, pl.ii. fig.22.

This species has been previously described by the above-named authors, from the upper part of the Aquitanian of the I. di Malo (Vicentin). As Lemoine and Douvillé have already pointed out, it may be readily distinguished from *L. angularis* by its external form; otherwise in certain respects they seem to be allied.

L. munieri occurred in the Malekula limestone at Bartaleppe.

LEPIDOCYCLINA ANDREWSIANA Jones & Chapman. (Pl. xxxix., fig.10).

Prof. Silvestri in writing recently upon the variant forms of the type *Lepidocyclina dilatata* Michelotti sp.* has included the above species in the synonymy of Lemoine and Douvillé's *L. tournoueri.*† Should the two forms be proved identical, the earlier name *L. andrewsiana* is the one to retain. For the present, however, I am content to regard the two forms as distinct, since *L. andrewsiana* possesses very solid divergent pillars seen in vertical section, whilst the entire structure of the shell is more compactly built than in *L. tournoueri.* In the latter, moreover, the swollen central area is less pronounced and more irregular in contour, *L. andrewsiana* being practically sub-

* Atti Pont. Accad. Rom. Nuovi Lincei, Anno lix. 1906, p.148.

† Mem. Soc. Géol. France, No.32, 1904, p.19, pl.i. fig.5; pl.ii. figs.2, 14; pl.iii. fig.1.

spherical inside the flange, and this feature is constant in all the specimens I have seen.

vi. Summary of Results.

The present study of the Malekula foraminiferal rocks has brought to light some interesting facts in distribution. Chief among these are :—

(1) The occurrence of *Trillina* in the New Hebrides, a genus already proved to exist in southern Australia and the Philippines, which thereby seems to connect up the southern coast of Australia with the outlying islands of eastern Australasia and certain portions of the East Indian Archipelago, along which line in Oligocene and Miocene times there probably existed a shallow-water area where such littoral forms could flourish.

(2) The new species of *Alveolina* found in the Malekula limestone, although not previously described, had already been figured from Javan Miocene limestones, and thus a relationship is shown with the latter rocks.

(3) By the discovery of *Lepidocyclina angularis* at Malekula, already known from Miocene limestone in the Loo-Choo Islands, off Japan, there is shown a further extension of the Miocene shore-line as far north as Japan.

(4) The two species of *Miogypsina*, *M. burdigalensis* and *M. complanata*, are here found in rocks at about the same horizon, although they are not actually associated in the same limestone specimen, as was the case at Santo.* Thus the present occurrence affords additional evidence of the contemporaneity of the two species which elsewhere indicate strata of different ages. Samples 105 and 108 have three species of *Lepidocyclina* in common, which supports the idea of their belonging to the same zone.

(5) *L. munieri* has already occurred at Vicentin in Europe, in the Upper series of beds of Aquitanian age.

(6) *L. verbeeki* is perhaps one of the most widely distributed of the Miocene forms of the *Orbitoidinæ*, since Newton & Holland

* Proc. Linn. Soc. N. S. Wales, 1905, Vol.xxx., p.273.

record it from Borneo and the Loo Choo Islands, whilst Prof. Rupert Jones and the author identified it in the Miocene limestones of Christmas Island. Verbeek had it from Java, and it is recorded with some reservation by Lemoine & R. Douvillé from certain rocks in Spain.

(7) Evidence of oscillation of the Miocene shore-line in the neighbourhood of the New Hebrides is afforded by the occurrence of beds largely composed of *Globigerinæ* mixed with fine tuffaceous material, in close association with the limestones containing shallow-water reef-forming organisms, but itself must have been formed at some considerable depth, as shown by the vast accumulation of the pelagic globigerine shells.

(8) The two important reef-building agents of foraminiferal origin at the present day, namely *Carpenteria rhaphidodendron* and *Polytrema planum*, are here shown to have undoubtedly performed similar work in Miocene times.

(9) The Miocene genus *Linderina*, by its present occurrence, has its range extended farther eastward.

EXPLANATION OF PLATES.

Plate xxxvii.

Fig.1.—***Operculina complanata*** **Defr. From the older limestone, Malekula; spec. No.108 (× 14).**

Fig.2.—***Lepidocyclina munieri*** **Lemoine & R. Douvillé,** ***L. angularis*** **Newt. & Holl., and** ***Operculina complanata*** **Defr. From the older limestone, Malekula; spec. No.108 (× 14).**

Plate xxxviii.

Fig.3.—***Lepidocyclina angularis*** **Newt. & Holl., and** ***Operculina complanata*** **Defr. Vertical sections. Malekula; spec. No.108 (× 14).**

Fig.4.—***L. angularis*** **Newt. & Holl. Horizontal and median section. Malekula; spec. No.108 (× 14).**

Fig.5.—***Alveolina cucumoides,*** **sp.nov. Median section. Malekula; spec. No.108 (× 28).**

Fig.6.—***A. cucumoides,*** **sp.nov. Longitudinal section. Malekula; spec. No.108 (× 28).**

Plate xxxix.

Fig.7.—*Trillina howchini* Schlumberger. Longitudinal section. Malekula; spec. No.108 (× 28).

Figs.8 and 9.—*T. howchini* Schlum. Transverse sections. Malekula; spec. No.108 (× 28).

Fig.10.— *Lepidocyclina andrewsiana* Jones & Chapman. Vertical section. From the older limestone, Malekula: spec. No.105 (× 14).

Plate xl.

Fig.11.—*Polytrema planum* Carter. From limestone probably of Post-Miocene age. Port Stanley; spec. No.87 (× 36).

Fig.12.—Cavernous and granular limestone with encrusting calcareous algæ of (?) Post-Miocene age. Port Stanley; spec. No.88 (× 28).

Plate xli.

Fig.13.—(?) Post-Miocene limestone showing *Amphistegina lessonii* d'Orb., *Orbulina universa* d'Orb., *Pulvinulina* sp., and a section of an echinoid spine. Laleppe, Malekula; spec. No.102 (× 36).

Fig.14.—Post-Miocene limestone from E. Coast, Malekula, spec. No.91A. Showing *Sphæroidina dehiscens* P. & J. (× 36).

Fig.15.—Post-Miocene limestone from E. Coast, Malekula; spec. No.91B. Showing abundant *Halimeda* and a vertical section of *Textularia trochus* d'Orb. (× 14).

ON A COLLECTION OF DRAGONFLIES FROM CENTRAL AUSTRALIA, WITH DESCRIPTIONS OF NEW SPECIES.

By R. J. Tillyard, M.A., F.E.S.

(Plate xlii.)

Up to the present time nothing whatever has been known regarding the Odonata of that vast tract of territory lying east and west of the overland telegraph route from Oodnadatta to Pine Creek. Thanks, however, to the keenness and energy of Mr. J. F. Field, late of Tennant's Creek, N.T., a large number of specimens from that locality have lately been secured. The collection was made during a period of over a year, from September, 1905, to December, 1906, and comprises some three hundred specimens. As might be expected in a district with so scanty a rainfall, the number of species is few, yet the collection forms a basis on which to build a knowledge of the Odonata of the most inaccessible region in Australia.

Tennant's Creek lies well within the Northern Territory, being some six hundred miles inland from Port Darwin, and a somewhat farther distance from the South Australian railway terminus at Oodnadatta. Its longitude is approximately 134° E., and its latitude 19° 30′ S. Hence it is clear that the Odonata of this locality may be regarded as fairly typical of the vast area of arid country in Central Australia. Though the locality is well within the tropics, yet the collection exhibits no definite tropical forms; and it is extremely probable that the tropical species which occur

so abundantly along the coast of the Northern Territory and Queensland have altogether failed to establish themselves any distance inland, owing to the altered conditions of climate.

Of the ten species in the collection, two are new and exceedingly interesting forms. One of these is the type of a new and remarkable genus. Of the remaining eight, one is the cosmopolitan *Pantala flavescens* Fabr., which appears to be very scarce; the other seven are species which are common over the whole of Australia.

The following is an analysis of the three hundred and twenty specimens which I have examined :—

Name.	Males.	Females.	Total.
Pantala flavescens Fabr.	2	2	4
Diplacodes hæmatodes Burm.	43	53	96
,, *bipunctata* Brauer	3	0	3
Orthetrum caledonicum Brauer	34	2	36
Hemicordulia tau Selys	4	0	4
Hemianax papuensis Burm.	0	1	1
Lestes aridus, n.sp.	81	30	111
Austrosticta Fieldi, n.sp.	3	2	5
Ischnura delicata Selys	16	19	35
Xanthagrion erythroneurum Selys	15	10	25
Total	201	119	320

There were also several nymphs of *Ischnura delicata*.

LESTES ARIDUS, n.sp.

(Plate xlii., figs. 4-5.)

♂. Total length 41 mm., abdomen 32 mm. Wings: fore 22 mm., hind 21 mm.

Wings: *Neuration* black; *pterostigma* 1·3 mm., dark brown. *Nodal Indicator* $\begin{vmatrix} 2 & 9\text{-}10 \\ 2 & 8\text{-}9 \end{vmatrix}$ Head: *Eyes* dark brown; *occiput* marked with a pale transverse line about 1 mm. long, slightly enlarged on each side, where it meets the eye, into a small oval spot; *epicranium* black; *ocelli* black, each surrounded by a conspicuous pale brownish ring; *antennæ* black, a very pale

spot at the base, in front, and another on the basal joint; *clypeus*, *labrum* and *labium* pale greyish-brown, this colour extending on to the eyes on either side; *mouth* edged with black. Thorax: *Prothorax* dull blackish with three greyish-blue spots, and a pale collar behind. *Meso-* and *metathorax* dull bronzy-black, a fine line along the dorsal ridge; a pair of humeral bands, pale straw-coloured in the young male, greyish-blue in the mature insect; these are followed on each side by a band of the groundcolour, the rest of the sides being greyish-blue, shading to greyish-brown underneath. *Notum* of immature male dull orange; in the mature insect the scuta and scutella are pale blue. *Legs* black above, pale brownish beneath, coxæ pale brownish. Abdomen slender; 1-2 and 7-10 very slightly thickened. Colour: 1, pale blue, with an irregular black dorsal patch: 2, dark metallic green, enclosing a long irregular dorsal blue spot, shaped somewhat like a bishop's mitre, and enlarged at the anal end of the segment: 3-7, dark metallic green, a broad transverse blue band at the base of each, and a narrow dorsal blue line extending to the anal sutures; in 3-5 this line ends in a narrow spear-head mark: sides of 2-7 pale greyish-blue, sutures black: 8, dark metallic greenish-black, a pale blue dorsal line, anal suture black: 9, pale blue, a narrow transverse basal black line: 10, pale blue. Appendages: *Superior* 1·2 mm., forcipate, black, slightly downy; the inner margin slightly hollowed out towards the tips, and carrying a large spine just beyond the middle; outer margin with several minute spines or teeth. *Inferior* 0·5 mm., close together, subconical, pale brownish.

♀. Total length 38 mm., abdomen 28·5 mm. Wings: fore 23 mm., hind 22 mm.

Pterostigma slightly longer than in male, markings of thorax pale straw-coloured. Abdomen cylindrical, thicker than in male, 8-10 slightly swollen. Colour dull metallic greenish-black, marked as follows: 1-2 as in male, but duller: 3-7 with the basal bands narrower than in the male, the dorsal line straight and regular, and bordered by two small slanting black spots about 1 mm. from the anal end of each segment; colour of markings

dull bluish or greyish; sutures of 2-7 broadly black: 8 with no dorsal line, but a pair of tiny black dorsal spots, a pale transverse band in the sutures of 7 and 8: 9 unmarked: 10 with basal third irregularly black, rest pale greyish or brownish. Ovipositor brownish, carrying two short filaments. Appendages 0·6 mm., wide apart, narrow subconical, pale brownish, tips slightly darker.

Hab.—Tennant's Creek, N.T.; common round the waterholes; September-April. Probably widely distributed in Central Australia.

This species is very closely allied to *Lestes leda* Selys, and to *L. analis* Rambur, especially the latter. The male may be readily distinguished from all other Australian species of the genus by the *last two segments* of the abdomen being pale blue. The female would be difficult to separate from those of the above-mentioned species, except for the small slanting dorsal black marks on segments 3-8, which, however, are not always very conspicuous in dried specimens. The appendages of the male differ considerably from those of *L. analis*, male, being smaller, and not bent backwards at all at the tips (Plate xlii., figs.3-4). The young insects appear to have the orange-pink colour of young specimens of *L. analis*, especially on the notum; and it is probable that the blue colour of the living insect is very pale, as in *L. analis*, and not rich blue as in *L. leda.*

AUSTROSTICTA, n.g.

Abdomen of both sexes short and rather thick. Superior appendages of male *straight*, inferior forcipate and projecting beyond superior. Wings petiolate to the level of the second antenodal; inferior sector of triangle absent. Basal postcostal nervule *placed further from base of wing than the first antenodal.* Superior sector of triangle terminating *well beyond the vein descending from the nodus*, forming three large cells and one small one along the postcostal margin. Median sector arising *slightly before* the nodal cross-vein. Postnodals 7-9.

Allied to *Isosticta* Selys, from which it differs in the following important points:—

Genus *Isosticta.*

Head narrow, thorax and abdomen very slender. Superior appendages of male *forcipate.* Basal postcostal nervule *before* first antenodal (Pl.xlii., fig.1,*a*). Superior sector of triangle terminating *at* level of nodus, forming *one or two* postcostal cells (fig.1,*b*). Median sector arising at the nodal cross-vein (fig.1,*c*). Postnodals 10-13.

Genus *Austrosticta.*

Head and thorax stouter, abdomen thicker and shorter. Superior appendages of male *straight.* Basal postcostal nervule *after* first antenodal (Pl. xlii., fig.2,*a*). Superior sector of triangle terminating *beyond* level of nodus, forming *three large and one small* postcostal cells (fig.2,*b*). Median sector arising *slightly before* the nodal cross-vein (fig.2,*c*). Postnodals 7-9.

AUSTROSTICTA FIELDI, n.sp.

(Plate xlii., figs.6-9).

♂. Total length 37 mm., abdomen 29 mm. Wings: fore 21 mm., hind 20 mm.

Wings rather narrow, fragile; *neuration* very open and thin; *pterostigma* trapezoidal, 0·8 mm., pale brownish. *Nodal Indicator*
2 8-9 | .
2 7-8 |
Head narrow, width 3·5 mm. *Eyes* brown, black behind next occiput; *epicranium* black, a pale straw-coloured line along the occipital ridge, and a curved line of the same colour in front near the clypeus; *ocelli* black; *antennæ* black with pale brown bases; *postclypeus* black, *anteclypeus* brownish spotted with black; *labrum* bright orange-brown; *labium* very pale straw-colour. Thorax: *Prothorax* rather large, pale straw-colour, with a large squarish dorsal patch of dark metallic green, covering nearly the whole dorsal surface. *Meso-* and *metathorax* dark metallic green; a fine straight dorsal line; a pair of narrow humeral bands, slightly curved, straw-

coloured, followed below on each side by an equal and parallel band of the groundcolour; rest of sides and underside pale straw-colour. *Legs* straw-colour, touched with black near joints. Abdomen cylindrical, rather stout, 8-10 somewhat clubbed. Colour: dorsal surface dark metallic green, broken at the sutures (except for a very fine mid-dorsal line) by narrow transverse bands of pale straw-colour. Sides straw-colour shaded with green; sides of 8-9 shaded with dark brown; 10 exceedingly small, straw-coloured, a small square dorsal spot of dark metallic green. Appendages very remarkable. *Superior* about 1 mm., slightly separated, broadly subcornute, pale straw-colour. *Inferior* very large, projecting nearly 0·5 mm. beyond superior; bases wide, subconical, pale straw-colour; the extremities, however, thin, black, forcipate; separated by a small projection on segment 10. Seen sideways, they appear to curve slightly upwards (Plate xlii., figs.6, 8).

♀. Very similar to male. Wings slightly longer, head and thorax slightly larger. Abdomen very slightly broader, 8-10 enormously clubbed; colour same as in male; 10 projecting below appendages into a black rounded tubercle. Ovipositor reaching beyond end of 10, brownish, with a pair of black divergent filaments 0·5 mm. long. *Appendages* close together, short, 0·5 mm., subconical, brownish.

Hab.—Tennant's Creek, N.T.; very rare; two males and a female in poor condition; April, 1906.

A most remarkable insect, but dull-coloured and very likely to be overlooked. Easily distinguished from its nearest relative, *Isosticta simplex* Martin, by its shorter and thicker abdomen and by the generic characters given above.

In conclusion, I wish to tender my heartiest thanks to Mr. J. F. Field for the interest and keenness with which he undertook to supply me with specimens, and to his aboriginal servant, Billy, who wielded the net with the greatest sagacity and discrimination, and evidently handled the specimens with much care.

EXPLANATION OF PLATE XLII.

Fig. 1.—*Isosticta simplex* Martin; wing.
Fig. 2.—*Austrosticta Fieldi*, n.sp.; wing.
Fig. 3.—*Lestes analis* Rambur ♂; appendages, seen from above.
Fig. 4.—*Lestes aridus*, n.sp. ♂; appendages, seen from above.
Fig. 5.— ,, ,, n.sp. ♀; appendages, seen sideways.
Fig. 6.—*Austrosticta Fieldi*, n.sp. ♂; appendages, seen from above.
Fig. 7.— ,, ,, ,, ♀; appendages, seen from above.
Fig. 8.— ,, ,, ,, ♂; appendages, seen sideways.
Fig. 9.— ,, ,, ,, ♀; appendages, seen sideways.

MEMOIR ON A FEW HETEROPTEROUS HEMIPTERA FROM EASTERN AUSTRALIA.

By G. W. Kirkaldy, F.E.S.

(Plate xliii.)

This memoir records the Heteroptera collected by Mr. A. Koebele and Dr. R. C. L. Perkins in Queensland, and by Mr. Koebele in New South Wales. These expeditions were carried out under the auspices of the Hawaiian Sugar Planters' Association at Honolulu, for the purpose of discovering and forwarding predators and parasites for the control of certain insect pests of sugar cane in the Hawaiian Islands; and the resulting collections are preserved in the cabinets of the Division of Entomology. The Homoptera have already been worked out.* The Heteroptera were not specially collected, and were merely a side issue; nevertheless I am able to add, as I believe, seven new genera and twenty-five new species.

The Plate has been prepared by Mr. W. E. Chambers, Illustrator of the Station.

The captures are as follows, novelties in italics:—

Cimicidæ: Stictocarenus sp., Panaetius lobulatus, Cuspicona thoracica, Testrica rudis.

Pyrrhocoridæ: Syncrotus circumscriptus.

Geocoridæ: Graptostethus cardinalis, *Cymus vulturnus*, Nysius vinitor, *Phaenacantha australiæ*, *Pachygrontha austrina*, *Phlegyas vulturnus*, *Macropes anthropophagorum*, Oxycarenus lifuanus, *Geocoris roseobistriatus*, *G. capricornutus*, *G. lubra*,

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* 1906, Bull. Ent. Hawaiian Sugar Planters' Assoc. i. 269-479, Pl.xxi.-xxxiii.; 1907, *op. cit.* iii., 1, Pl.i.-xx. and figs.

Germalus kurandæ, Botocudo ornatulus, *Orthoea sidnica*, O. pacifica, *Vulturnia albo-notata*, *Thaumastotherium australicum*.

TINGIDÆ: *Serenthia vulturna*, *Hypsipyrgias telamonides*, *Epimixia alitophrosyne*, *Teleonemia pacifica*, *T. vulturna*.

NABIDÆ: *Alloeorhynchus flavolimbatus*, Gorpis cribraticollis, *Acanthobrachys virescens*.

REDUVIIDÆ: Ptilocnemidia plumifer.

GERRIDÆ: *Rhagovelia australica*.

ANTHOCORIDÆ: Triphleps persequens.

CLINOCORIDÆ: Clinocoris lectularius.

MIRIDÆ: *Eurocrypha thanatochlamys*, *Cysteorrhacha cactifera*, *Helopeltis australiæ*, *Synthlipsis chambersi*, *Paracalocoris austrinus* (and a few other solitary Mirids, which I cannot determine at present).

NAUCORIDÆ: Ochterus marginata.

CORIXIDÆ: Micronecta annæ var. *pallida*, *M. micra*.

CIMICIDÆ.

STICTOCARENUS Stal.

1. S.sp.?

Hab.—N.S.W.: Sydney (Jan.; Koebele).

PANAETIUS Stal.

2. P. LOBULATUS Stal.

Hab.—Q.: Kuranda (Perkins); N.S.W.: Sydney (Jan.; Koebele).

CUSPICONA Dallas.

3. C. THORACICA (Westwood).

Hab.—N.S.W.: Sydney (Jan.; Koebele). I have it also from Victoria, in my own collection.

TESTRICA Walker.

4. T. RUDIS (Germar).

Hab.—N.S.W.: Sydney (Jan., Feb.; Koebele). Previously recorded from South Australia also.

PYRRHOCORIDÆ.

SYNCROTUS Bergroth.

4A. S. CIRCUMSCRIPTUS Bergroth.

Hab.—Q.: Kuranda (June; Perkins); a single male measuring 6 mill., and agreeing fairly with Bergroth's description.

GEOCORIDÆ.

GRAPTOSTETHUS Stal.

5. G. CARDINALIS (Stal).

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

CYMUS Hahn.

6. C. VULTURNUS, sp.nov.

Pale brownish-yellow, scutellum and anterior part of pronotum, etc., tinged with ferruginous; keels on pronotum and scutellum clear pale yellow. Tegmina pale yellow, apical margin of corium narrowly fuscous; membrane hyaline. Fourth segment of labium black. Second segment of antennæ longer than the first, which reaches beyond the head, and a trifle longer than the fourth; third equal to second and fourth together. Length $4\frac{1}{2}$ mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

Allied to *C. tabidus* Stal, but larger, and the second segment of the antennæ a little longer than the fourth.

NYSIUS Dallas.

7. N. VINITOR Bergroth.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele). Also from New South Wales and Victoria; and recently introduced into the Hawaiian Islands.

PHAENACANTHA Horvath.

8. P. AUSTRALIÆ, sp.nov.

Closely allied to *P. ambigua* Horv., but differing as follows: head distinctly wider than pronotum, and pallid except for two

narrow lines from antennæ to ocelli; fourth segment of antennæ longer than third. Scutellar spine about 70°. Length 7½ mill.

Hab.—Q.: Kuranda (August; Perkins).

PACHYGRONTHA Germar.

9. P. AUSTRINA, sp.nov.

Pale brownish-yellow, closely punctured on head, thorax, and tegmina (except membrane) with brown or black; lateral margins of pronotum very narrowly, and a line down the middle of the pronotum and scutellum, smooth, pale yellow. Eyes, last segment of rostrum, and a median line along the last sternite, blackish. Antennæ brownish-yellow, somewhat fuscate. Meso- and metasterna medianly dark fuscous. Membrane hyaline. Legs brownish-yellow, thickly speckled with blackish-brown. Sternites ferrugineo-testaceous; lateral margins widely, and apical third, fuscous. First segment of antennæ much longer than the second; second subclavate apically, much longer than the third, which is twice as long as the fourth, the four together a little longer than the entire body. Tegmina not quite reaching to the apex of the abdomen. Fore femora with mixed spines. Length 10 mill.

Hab.—Q.: Kuranda (August; Perkins).

PHLEGYAS Stal.

10. P. VULTURNUS, sp.nov.*

Apparently allied to *P. burmanus* Distant, from which, judging by the figure and the meagre description, it differs by the pronotum being strongly punctured, with the central keel rather indistinct, and the fore femora spinose. Blackish; median part of vertex across, anterior margin of pronotum narrowly in the middle, and a small irregular area behind that (divided by the dark keel), fore femora dorsally (usually), fore tibiæ and tarsi

* If Distant's figure of the Mexican *P. tropicalis* be correct, the latter is certainly not congeneric with *P. burmanus*.

(mostly), antennæ, labium, etc., reddish-brown or yellowish-brown, the appendages somewhat varyingly suffused with fuscous. Scutellum red-brown, posteriorly more yellowish, the anterior angles and a median spot anteriorly, blackish. Tegmina pale brownish-yellow, strongly punctured with honey-yellow and brown, a fuscous brown spot near apex of corium, and another sometimes at inner apical angle. Sterna and sternites black, a wide interrupted stripe down the pleura medianly, the ambulacra, etc., pale red-brown. Sternites medianly pale yellowish-brown, the pleurites the same, with blackish-brown spots at intervals. The whole underside strongly punctured. Middle and hind legs pale brownish-yellow; basal three-fourths of femora more or less blackish-brown; tibiæ incompletely ringed with blackish-brown near the base and near the apex, tarsi more or less fuscous, claws black. Labium reaches to about the base of the prosternum. Antennæ 8, 17, 18, 22. The fore femora are rather more strongly incrassate than in *P. burmanus*, and are armed with two colourless longer spines and several darker ones of varying lengths. Length $3\frac{7}{8}$-4 mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

Sometimes the black hue is more overspread, especially on the legs.

MACROPES Motschulsky.

11. M. ANTHROPOPHAGORUM, sp.nov.

Reddish-brown, covered with short, pale yellow hair; basal half of pronotum pale, except at posterior angles. Eyes and two apical segments of labium blackish. Tegmina brownish-yellow with a clearer area along the middle, membrane hyaline with fuscous veins. Ambulacra, tibiæ and tarsi brownish-yellow. First segment of antennæ reaching as far as the apex of the head, 8, 10, 8, 15. Labium not reaching quite so far as the fore coxæ. Posterior margin of pronotum roundly emarginate. Tegmina not nearly reaching to the middle of the abdomen; membrane longer medianly than the corium, roundly truncate apically. Length $4\frac{1}{2}$ mill.; pronotal width $\frac{4}{5}$ mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

The colour and the short labium and tegmina will distinguish this at once.

OXYCARENUS Fieber.

12. O. LIFUANUS Kirkaldy.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele). Originally described from Lifu, into which it is perhaps a recent introduction.

GEOCORIS Fallén.

13. G. ROSEOBISTRIATUS, sp.nov.

Pale ochraceous; eyes, ocelli, three longitudinal percurrent (the two lateral angularly convergent) lines on vertex, apical half of second and of third segments of antennæ, six longitudinal percurrent lines on pronotum, scutellum medially, pleurites, an oblique line on genæ, etc., rose-red. Pronotum fuscously punctured, an opaque area subanteriorly (with a transverse faint fuscous line), and rather more sparsely punctured posteriorly. Tegmina hyaline, yellowish-tinged, corium with three rows of fuscous punctures. Abdomen blackish (except as mentioned above). Labium reaching to about the middle trochanters, first two segments subequal. Antennæ 9, 20, 15, 17. Hind margin of pronotum about one-seventh wider than the head. Length 5 mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

In very bad condition, but so distinct that I have ventured to describe it.

14. G. CAPRICORNUTUS, sp.nov.

Rather elongate; shining black; underside of head (except basally at the side), antennæ (except the fuscous base of the third, and apical five-sixths of the fourth), legs, pleurites (except the incisures), a sublateral streak down the basal half of the corium, and a broad stripe down the middle of the posterior three-fourths of the scutellum, pale yellow. Labium brownish-yellow. Ocelli red. Eyes dark fuscous, paler ventrally. Membrane dark smoky. Head one-eighth wider than the pronotum.

Antennæ 13, 27, 23, 28. Labium reaching to the apex of the middle coxæ. Pronotum punctured, a subanterior area on each side and the posterior margin lævigate. Anterior and lateral margins of the scutellum punctured. Clavus with a close row of punctures along the corial margin. Corium with the same along the claval margin, turning out a little posteriorly, and also a row near the lateral margin, and scattered feebler punctures apically. Length 4½ mill.

Hab.—Q.: Kuranda (August; Perkins).

15. G. LUBRA, sp.nov.

Head, pronotum, scutellum and under side black. Anterior margin of head (except medianly), postero-lateral angles of pronotum, tegmina, labium, legs, orifices, ambulacra, postero-lateral margin of metasternum, spots on pleurites, etc., testaceous, passing into pale ochraceous. Eyes dark fuscous anteriorly, reddish-fuscous posteriorly. Basal three-fourths of first and of second segments of antennæ dark fuscous, the rest testaceous. Membrane cinereo-hyaline. Pronotum very closely punctured except for a subanterior shining, somewhat swollen, smooth area on each side. Scutellum closely punctured, feebly keeled. Tegmina punctured much as in *G. kurandæ*, but with two subparallel rows on corium inwardly instead of one. Length 3 mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

GERMALUS Stal.

16. G. KURANDÆ, sp.nov.

♂. Ochraceous, eyes and ocelli reddish. Vertex with a short, thin, dark, longitudinal line apical of each ocellus, and two short median subcontiguous lines apically. Extreme apex of labium blackish. Antennæ with the third, apex of second and base of fourth segments sanguineous. Pronotum with a fuscous line down the middle, and a very short sublateral one on each side (only on the basal fourth), also the postero-lateral angles fuscous; pronotum closely punctured with dark fuscous, except the two anterior lævigate areas (which are immaculate ochraceous) and

the hind margin narrowly, also the anterior margin medially. Scutellum punctured except medially. Corium with three (somewhat narrowly suffused) dark rows of punctures, also exterolateral and apical margins narrowly dark. Clavus more sparsely and obscurely punctured. Membrane immaculate hyaline. Abdomen pale reddish-ochraceous. Sterna and pleura strongly punctured fuscously, abdomen beneath only feebly so. Legs yellowish. Eyes strongly pedunculate, head wider than hind-margin of pronotum. Antennæ 14, 42, 25, 38. Last "abdominal" sternite roundly emarginate.

♀. Median line on pronotum less distinct. Last sternite angularly emarginate, medially elongately produced. Length, ♂ 5; ♀ 6 mill.

Hab.—Q.: Kuranda (Aug.; Perkins).

BOTOCUDO Kirkaldy.*

17. B. ORNATULUS (Bergroth).

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele and Perkins).

This species is a little variable in colour and pattern.

ORTHOEA Dallas, Kirkaldy.

18. O. SIDNICA, sp.nov.

Allied to *O. nigriceps* (Dallas), but narrower and more parallel-sided at the tegmina; collar more distinct, anterior area of pronotum longer, hind area proportionately wider, hind margin straight. Tegmina more deeply punctured. Fore tibiæ longer (in the male at least). Head, posterior area of pronotum, posterior three-fourths of scutellum, etc., blackish; anterior area of pronotum and anterior part of scutellum, dark red-castaneous. Tegmina brownish-yellow strongly punctured with yellow and brown; a basal band across the base, a spot on the lateral margin towards the apex, apex of corium, etc., blackish. First three

* *Botocudo* Kirk., 1904=*Salacia* Stal, *aa* (restr. Dist. 1893). *Cligenes* Dist., 1893=*Salacia* Stal, *a*.

segments of antennæ brownish-yellow, fourth dark fuscous. Under side blackish, prosterna, a large spot on the middle of abdomen at base, etc., dark reddish-castaneous. Legs yellowish, except a broad dark ring across fore femora, apices of segments faintly fuscous. Length, ♂ 4½ mill.

Hab.—N.S.W.: Sydney (Feb.; Koebele).

19. O. PACIFICA (Stal) [= *periplanios* Kirkaldy].

Hab.—Q.: Cairns (Perkins). Also in Fiji and Hawaii.

VULTURNIA, gen.nov

I suppose that this is really allied to *Aphanus*, but I should have placed it near *Fontejus* had there been any collar.

Head triangular, declivous, but little narrower than the posterior margin of the pronotum, distinctly wider than the anterior area. Ocelli near base of head and eyes, probably scarcely functional. Pronotum with the anterior area about as long as wide, about as long as the head, subglobose, twice (or more) as long as the hind area, which is partly declivous, the posterior margin emarginate. Tegmina and abdomen medially narrowed, membrane not reaching the apex of the abdomen.

20. V. ALBONOTATA, sp.nov.

Black, thickly covered with short grey hair, also a few black bristles. Pronotum and scutellum closely punctured; clavus with three rows, corium with two inner and one outer row, also the apical third apex of first segment of antennæ and the fourth (3rd auctt.) ventral pleurite white. Hind angle of scutellum creamy. Basal half of tegmina opaque-testaceous, mostly infuscate; apical margin of corium broadly white (black punctures); membrane dark smoky, with a large pale fulvous spot at apex. Tarsi fuscous. Antennæ 9, 28, 23, 27. Labium reaching to about the middle coxæ, first segment not reaching the base of the head.

♂. Fore femora strongly incrassate, minutely spined; tibiæ slightly curved, not spined. Length 6 mill.; pronotal width 1½ mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

THAUMASTOTHERIINÆ, subfam.nov.

This subfamily, which is based on a single carded specimen. is allied to the *Blissinæ* in that the fore legs are articulated on the disk of the prosternum, but the structure of the head, labium, legs, etc., puts it quite out of that subfamily. In habitus, it recalls much more the *Anthocoridæ*, and even in some ways the *Polyctenidæ*; but the structure of the sterna and the lack of a cuneus place it in the *Geocoridæ*. I am unable to determine with surety whether it is Trochalopodous or Pagiopodous, but I think the former, in which case its Geocoridism would be confirmed. It is to be hoped that other specimens will be found, but unfortunately nothing is known of its habits.

THAUMASTOTHERIUM, gen.nov.

Flattish. Head flat, slightly declivous; juga much longer than tylus and meeting in front of it, laminately expanded anteriorly and laterally, the sides rotundately curved. Lateral margins of head, between the above and the pedicellate eyes, rounded. Head scarcely so long as its width. Eyes not quite contiguous with pronotum; ocelli contiguous with ocular peduncles, close to base of head. Antennæ about twice and one-half as long as the pronotum medianly, inserted ventrally low down, basal of the first segment of the labium, first segment not reaching to the apex of the head. Labium broad and short, reaching only to the middle of the prosternum. Bucculæ low, divergent apicalwards and very far apart, narrowing just apical of the second antennal segment, the first two apparently not free, third reaching to base of head. Pronotum behind a little wider than the head and a little wider than the fore margin, hind margin straight; impressed transversely in the middle, lateral margins fairly straight; (longitudinal) middle $\frac{3}{5}$ of anterior area flat, medially sulcate, lateral fifths swollen; hind area punctured, lateral margins swollen. Scutellum triangular, a little longer than wide, feebly keeled medially, transversely striate and punctured. Hind margin of prosternum straight, meso- and metasternum sulcate. Clavus and corium closely punctured, lateral margins of latter slightly

rounded and narrowly explanate. Membrane without apparent veins. [I have not examined the wings.] Legs all short, fore coxæ inserted on the disk of the prosternum, coxæ globular (as also the middle pair), shorter than the trochanters, femora greatly incrassate, longer than the tibiæ. Hind coxæ more elongate. Middle and hind femora incrassate, longer than their tibiæ. Tarsi minute, arolia very large, elongate, nearly as long as the claws.

21. T. AUSTRALICUM, sp.nov. (Pl.xliii., figs.1-3).

Ochreous. Third (except apex and base) and fourth segments of antennæ, tarsi and apex of labium, black. Eyes reddish-piceous. Tergites (except lateral margins) apparently dark fuscous, as also a part of the underside. Punctures brownish. Antennæ 3, 6, 8, 8, third and fourth segments sulcate. Length, ♂ 3½ mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

TINGIDÆ.

SERENTHIA Spinola.

22. S. VULTURNA, sp.nov.

Allied to *S. gibba* (Fieber), but the pronotum is much less convex. The first segment of the antennæ is one-half longer than the second, the third is twice as long as the fourth, and four and one-half times as long as the second. The metasternum is not pale posteriorly. The pronotum is evidently, though not strongly, percurrently carinate. Pronotum black, with a pale collar anteriorly (not encroaching posteriorly at the sides), and the posterior prolongation pale. Length 2⅛ mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

All the species of *Serenthia* in my collection are strongly brachypterous; the present form is less coriaceous and has a distinctly separated costal (or subcostal?) area, which is uniareolate. In these respects, this Australian species seems to approximate to *S. femoralis* Thomson, and *S. brevirostris* Yakovlev.

HYPSIPYRGIAS, gen.nov. (Pl.xliii., figs.4-5).

Somewhat allied to *Dichocysta* Champion, but with a very different pronotal structure. Head small, with a basal subporrect spine on each side laterally, one median immediately anterior, and one or two between the insertions of the antennæ. Second segment of antennæ about twice as long as the first, both short, third about ten times as long as the second and more than thrice as long as the broad fusiform fourth. Pronotum medianly very highly elevated and vesicular, truncate in profile, anteriorly acute-angled in profile, then perpendicular, the whole of the vesicle reticulate, not carinate. Lateral margin of pronotum areolately dilated, exteriorly rounded. Posterior lobe tricarinate, middle keel anteriorly lost in the big vesicle, posteriorly forming a small, elevated, areolate vesicle; the lateral keels run elevatedly by the side of the large vesicle as far as the anterior margin. Tegmina laterally rounded, widest at the level of the posterior angle of the pronotum, suddenly narrowed after the discoidal, thence continuing subparallel; discoidal area sharply limited; subcostal biareolate, becoming 3- or 4-areolate posteriorly; costal area uniareolate. Tegmina reaching far beyond abdomen.

23. H. TELAMONIDES, sp.nov.

Dark fuscous or pitchy; first three segments of the antennæ, bucculæ, legs, etc., reddish-testaceous. Pronotum dark fuscous; posterior lobe, anterior vesicle, venation, etc., yellowish. Tegmina yellow, a large fuscous spot at the apex, not, however, discolouring the veins. Length 3½; maximum height about 1½ mill.

Hab.—Q.: Kuranda (Aug.; Perkins).

This curious species has some little general resemblance to the American Membracid genus *Telamona* Fitch; the specific term *telamonides*, however, is not used to express this resemblance.

EPIMIXIA, gen.nov.

General appearance of *Teleonemia*, but the discoidal area is feebly marked off, and the subcostal area is multireticulate. Head with two sublateral spines near the base, and two sub-

median near the apex, all short; bucculæ prominent, anteriorly roundly acute. Antennæ slender, third segment more than twice as long as the fourth, more than five times as long as the second, and thrice and one-half as long as the first. Pronotum very convex behind, anteriorly narrowed, a small lævigate area on each side of the middle keel between the collar and the convex part; with three keels, the middle one percurrent, the lateral ones stopping anteriorly at the lævigate areas. Lateral margins rounded, not foliaceous but acutely carinate; no hood. Tegmina elongate, costal area uniareolate.

24. E. ALITOPHROSYNE, sp.nov.

Pronotum and tegmina very closely punctured. Head, lævigate areas, apex of tibiæ, the tarsi, underside, etc., blackish. Spines, keels, bucculæ, etc., yellowish-white. Legs red. Pronotum and tegmina yellowish, largely suffused, especially inwardly, with reddish, but not on the posterior lobe of pronotum. Length 4½ mill.

Hab.—N. S.W.: Sydney (Jan ; Koebele).

TELEONEMIA Costa.

25. T. PACIFICA, sp.nov.

Allied to *T. pilicornis* Champion.

Reddish-ochraceous or yellowish-ferruginous (♂), yellowish (♀), bucculæ, legs and sternal keels paler; apical four-fifths of last segment of antennæ blackish. Pronotal keels yellowish, interrupted with fuscous. Tegmina yellowish; a broad ferruginous band across middle of discoidal area, reaching the costal margins (♂), a less regular fuscous band (♀); membrane, except an apical spot, ferruginous (♂), or more or less fuscous (♀). Two large porrect basal spines on the head, and one or two smaller. Third segment of antennæ thrice as long as the fourth, and ten times as long as the second, which is a trifle shorter than the first. Labium reaching to base of mesosternum. No hood, but the middle keel of pronotum percurrent. Pronotum finely and closely punctured. Tegmina with discoidal area glabrous, areoles deeply

mpressed; subcostal area biareolate, costal area uniareolate, both minutely. Length 3 mill.

Hab.—Q.: Kuranda (August; Perkins)—Fiji Islands: Rewa (April; Muir).

26. T. VULTURNA, sp.nov.

Black or blackish; anterior margin, lateral margins, the three discal keels, posterior angle deeply—of pronotum—bucculæ, spines, sternal keels, posterior margin of prosternum, costal area, exterior margin of discoidal area, lateral margins of membrane, etc., pale. Two rather short basal spines on head, and others still smaller. No hood, but the middle keel of the pronotum percurrent. Pronotum finely and closely punctured. Tegmina with discoidal area glabrous, areoles deeply impressed; membranal areoles somewhat larger; costal area uniareolate; subcostal area 3-areolate, widening irregularly to 4. Length 3⅓ mill.

Hab.—Q.: Kuranda (Perkins).

NABIDÆ.

ALLOEORHYNCHUS Fieber.

27. A. FLAVOLIMBATUS, sp.nov.

Black (including the membrane which is rather, perhaps, dark smoky), the pronotum and sternites shining. Antennæ, labium, legs and a large spot at base of abdomen ventrally, brownish-yellow, the antennæ a little infuscate; a broad ring near the apex of the hind femora piceous, teeth on femora blackish. Basal half of corium laterally, basal two or three pleurites, and one or two apical spots, pale yellow.

Head and pronotum shaped differently from *A. vinulus*,* the pronotum in profile being gradually declivous, and the head perpendicular at the base. The head may be exserted, but not in repose (as erroneously figured by Distant), the eyes then touching the pronotum. The head is distinctly more elongate before the

* Judging, in this and later observations, by Distant's figure and description in 'Fauna of India.'

eyes than in *A. vinulus*. The second segment of labium is very long, reaching to the fore trochanters, the third reaching to the middle pair. Antennæ 3, 1, 5, 5, 6. The pronotal constriction is rather feeble in the middle, and the anterior area is distinctly longer than in *A. vinulus*, being about thrice as long as the hind area medianly, the latter being distinctly longer at the sides than in the middle. Femora much as in *A. vinulus*, but the fore tibiæ more widened; fore and middle femora each with a double row of about 17 teeth, tibiæ somewhat correspondingly but more bluntly toothed.

♀. Abdomen widened behind, black concolorous beneath. Length 5¼ mill., width 2 mill.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

GORPIS Stal.

28. G. CRIBRATICOLLIS Stal.

Hab.—Q.: Kuranda (August; Perkins). Also from Fiji: Rewa (Muir). Previously recorded from Ceylon, and like many other Nabidæ, probably easily introduced, so that its endemic habitat is doubtful.

ACANTHOBRACHYS Fieber.

29. A. VIRESCENS, sp.nov.

Intermediate between Stal's divisions *a* and *aa* (of *Arbela*), in that the hind area of the pronotum is distinctly and rather densely punctured, scarcely so, however, on the declivous hind margin, while there is no median pale line.

Head: first segment of antennæ, labium, and underside pale ochraceous or testaceous, probably greenish in life; rest of antennæ dark fuscous. Pronotum pale light green, hind margin infuscate, as also scutellum. Tegmina fuscous, lateral margins greenish-yellow. Legs greenish or greenish-testaceous, third segment of tarsi and the knees fuscous. Abdomen above sanguineous, except the lateral margins and the apical segment. First segment of the antennæ about twice and one-half as long as the head, subequal to second segment. Labium reaching to the middle coxæ, second

segment nearly reaching to base of prosternum, distinctly longer than the third. Length 6 mill.

♀. Hind tibiæ not clavate basally.

Hab.—Q.: Kuranda (Aug.; Perkins).

REDUVIIDÆ.

Ptilocnemidia Kirkaldy.

30. P. plumifer (Horvath).

Hab.—Q.: Brisbane (June; Perkins); previously recorded from Rockhampton, and from New South Wales.

GERRIDÆ.

Rhagovelia Mayr.

31. R. australica, sp.nov.

Apterous ♀. Head blackish-brown, a large roundly trifid mark at the base, and the apical margin in front of the eyes, yellowish-brown. Pronotum blackish-brown; the anterior margin broadly, a narrow line down the middle, and the hind margin broadly, yellowish-brown. Metanotum yellowish-brown, except the anterior margin narrowly and a median spot. Sterna and pleuræ yellowish-brown, with blackish-brown incisures, &c. Antennæ blackish-brown, except the yellowish-brown basal third of the first segment. Labium yellowish-brown, apex blackish-brown. Legs blackish-brown; ambulacra, coxæ, trochanters (except apical margin), basal half of fore femora, base of hind femora, &c., yellowish-brown.

Subfusiform; head much narrower than the pronotum, which is narrower than the metanotum; vertex triangular with truncate apex. Antennæ 10, 7, 6, 5. Labium reaching just beyond fore coxæ. Pronotum roundly hexagonal. Mesosternum obliquely ridged on each side, the keels almost contiguous apically, somewhat as in *R. peggiæ*. Middle tibia about as long as the subequal tarsal segments. Hind femora strongly incrassate, dentate,

tibiæ very slightly curved. Pleurites subvertical, narrowing in posteriorly. Length $4\frac{1}{8}$ mill.

Hab.—Q.: Kuranda (Aug.; Perkins).

ANTHOCORIDÆ.

TRIPHLEPS Fieber.

32. T. PERSEQUENS F. B. White.

Hab.—Queensland (Perkins); also Fiji (Muir). Previously known only from the Hawaiian Islands, into which it was an introduction.

CLINOCORIDÆ.

CLINOCORIS Fallén.

33. C. LECTULARIUS (Linné).

Hab.—Q.: Kuranda (Perkins).

MIRIDÆ.

EUROCRYPHA, gen.nov.

Differs from *Isometopus* Fieber, by the much smaller head, which, however, extends laterally and posteriorly beneath; and by the different antennæ.

Ovate, closely and minutely punctured. Head perpendicular, much narrower than the pronotum anteriorly, lateral margins beneath lobate, produced posteriorly, visible dorsally as a spine on each side behind the eyes. First three segments of antennæ apparently very short, fourth incrassate, extending as far as the base of the pronotum, five or six times as long as thick. Pronotum as in *Nesocrypha*; mesonotum bilobate, biemarginate. Tegmina as in *Nesocrypha*, but clavus narrowed posteriorly, and scutellum touching the base of the membrane (the latter destroyed). Tegmina hairy and declivous, as in *Nesocrypha*. Hind femora apparently not strongly incrassate.

34. E. THANATOCHLAMYS, sp.nov.

Blackish. Eyes reddish-pitchy, ocelli dark rubid. Posterior angle of scutellum sanguineous. Tegmina brownish-pitchy. Last

segment of antennæ brownish-yellow. Length $2\frac{1}{4}$ mill., to apex of cuneus.

Hab.—Q.: Bundaberg (Sept.-Dec.; Koebele).

CYSTEORRHACHA, gen.nov.

A genus of the *Bryocorini*. Pilose and lightly punctured. Vertex transverse, a little wider than an eye, deeply sulcate; with eyes, twice and one-fourth as wide as long. Head vertical before the eyes, which do not touch the pronotum. Rostrum reaching to (or beyond ?) the middle coxæ. Second segment of antennæ more than twice as long as the thicker first, one-third longer than the third (fourth broken). Pronotum basally twice and one-half as wide as anteriorly and about one-half wider than the head; three-fourths wider basally than the length, twice as long as the head; constricted about the middle, widening posteriorly, basal margin emarginate; a distinct collar. Posterior half of scutellum elevated and swollen, curving cystiformly forward over the basal lobe of the pronotum, biconstricted, with a small, erect, dorsal spine, in front of the anterior constriction. Tegmina without a median vein, cuneus acute posteriorly, (membrane destroyed). Hind tarsi with the third segment as long as the other two in profile, second a little more than half the length of the first; arolia long and narrow, curved outwards and inwards, three-fourths the length of the curved claws, from which they are separated.

35. C. CACTIFERA, sp.nov. (Pl. xliii., figs.6-7).

Dull ferrugino-fuscous, partly suffused with sanguineous. First segment of antennæ yellow, apically reddish, second and third dark sanguineo-fuscous. Postero-lateral angles of pronotum rather widely fuscous, the hind margin very narrowly pale. Sterna and abdomen dark sanguineous. Tegmina hyaline, a large spot at base and a broad median band, fuscous; apical margin of corium broadly dark sanguineous; cuneus opaque white, posterior angle dark sanguineous. Wings hyaline. Legs dark

sanguineous, femora basally pale, fore and middle tibiæ pallidly annulated near the apex, hind tibiæ apically pale.

♀. Length to apex of cuneus, 5 mill.

Hab.—Queensland (Aug.; Perkins).

HELOPELTIS Signoret.

36. H. AUSTRALIÆ, sp.nov.

♂. Head and apical third of abdomen shining black; ocular orbits, clypeus, labium (except apex), underside of head, sterna, etc., pale yellowish. First segment of antennæ piceous, apex red-brown, second and third black (fourth absent). Pronotum and scutellum yellowish-orange, disk of the former redder, horn fuscous. Tegmina dark cinereous-hyaline, exterior margin, veins and apical margin of corium olivaceous. Coxæ yellowish, rest of legs olivaceo-testaceous, femora annulated with olivaceous. Abdomen basally pale fuscous. Head and eyes nearly as wide as the hind margin of the pronotum. Second segment of antennæ one-half longer than the first and about one-seventh longer than the third. Labium about three-fourths of the length of the first segment of the antennæ, reaching nearly to hind coxæ. Horn about three-seventh of the length of the first segment of the antennæ, straight, evenly cylindric right up to the capitate apex, apparently erect (but partly broken at the base and lying on its side). Length 6 mill.

Hab.—Q.: Kuranda (Aug.; Perkins).

SYNTHLIPSIS, gen.nov.

Belongs to the *Capsini*, but has no close relations.

Eyes slightly pedicellate, raised distinctly about the level of the vertex, subcontiguous to collar. Vertex longitudinally sulcate, with eyes not so wide as the pronotum behind. Second segment of antennæ elongate, flattened and widened gradually from the middle to the apex, which is narrowly rounded. Pronotum constricted strongly, a trifle in front of the middle, base of anterior area slightly narrower than the apical margin; lateral

margins of hind area divergent; hind margins a little sinuate. Cuneus elongate. Membrane with two cells, the inner almost oblong, obliquely truncate apically.

37. S. CHAMBERSI, sp.nov. (Pl.xliii., fig.8).

Shining orange-red; legs, etc., paler. Eyes blackish. Antennæ dark reddish-fuscous. Membrane hyaline, apically smoky, veins scarcely red. Wing-veins pale fuscous. Abdomen dark blood-red. Hind tibiæ with three pale fuscous rings. Head, pronotum, and scutellum not punctured. Antennæ 25, 100, 25, 23, the first segment half as long as the width of the pronotum apically. Hindmargin of pronotum three-fifths longer than the apical margin. Length 6 mill.

Hab.—Q.: Kuranda (Aug.; Perkins); one female in poor condition.

I have pleasure in naming this after Mr. W. E. Chambers, who has adorned my recent memoirs with many fine drawings.

PARACALOCORIS Distant.

38. P. AUSTRINUS, sp.nov.

Ochreous-brown, with pale golden-yellow pubescence. Head with a black impression just basal of the antennal insertions. First segment of the antennæ dark reddish-fuscous, second ochreous-fuscous with the apical half blackish, third dark fuscous with the base pale ochreous. Labium pale ochreous-fuscous, third segment and apex of the fourth blackish. Collar narrowly margined posteriorly with black. Pronotum with two pale smoky-fuscous broad bands down the middle of the hind area. The transversely impressed line on the scutellum blackish, anterolateral angles broadly pale smoky-fuscous. Corium mostly suffused with pale smoky-fuscous; cuneus subsanguineous, apical margin smoky. Commissural margin narrowly blackish. Membrane hyaline, apical margin irregularly dark smoky; veins blackish, apical angle of the inner cell suffused. Mesopleuræ each with a large blackish spot; underside generally more or less

suffused with fuscous, or with fuscous lateral markings. Legs brownish, obscurely ringed with testaceous. Antennæ 58, 100, 25 (?), first segment flattened and ovally widened, second elongately clavate. Anterior impressions of pronotum small; two spots on hind areas scarcely impressed. Length, ♀, about 5¾ mill.

Hab.—Q.: Kuranda (Aug ; Perkins).

NAUCORIDÆ.

OCHTERUS Latreille.

39. O. MARGINATA (Latr.)

Hab.—Q.: Kuranda (Perkins). The nymph.

CORIXIDÆ.

MICRONECTA Kirkaldy.

40. M. ANNÆ Kirkaldy var. PALLIDA nov.

No transverse line on pronotum; tegmina with a pale castaneous basal band.

Hab.—Q.: Kuranda (Aug.; Perkins).

41. M. MICRA, sp.nov.

Pale brown, brownish-testaceous beneath; a pale castaneous band at the base of the tegmina, lateral margins with one or two dark specks. Abdomen above partly dark. Head well rounded in front of eyes, which are practically contiguous with the corium. Pronotum very short, narrower than the head, *hind margin truncate*. Length 2 mill.

Hab.—Q.: Kuranda (Aug ; Perkins).

EXPLANATION OF PLATE XLIII.

Figs. 1-3.—*Thaumastotherium australicum*, gen. et sp. nov.
Figs. 4-5.—*Hypsipyrgias telamonides* gen. et sp. nov.
Figs. 6-7.—*Cysteorrhacha cactifera*, gen. et sp. nov.
Fig. 8.—*Synthlipsis chambersi*, gen. et sp. nov.

SOLANDRINE, A NEW MIDRIATIC ALKALOID.

By James M. Petrie, D.Sc., F.I.C., Linnean Macleay Fellow of the Society in Bio-Chemistry.

(From the Physiological Laboratory of the University of Sydney).

Solandra lævis, from which this alkaloid was obtained, is a tropical evergreen shrub of the natural order Solanaceæ, tr. atropeæ, and is indigenous to South America and the West Indies. It grows plentifully in Australia, and used to be quite a common plant in suburban gardens, but of recent years has become scarce.

Attention was first drawn to the dangerous nature of the sap of Solandra by the following accident. A gardener who, while pruning, had some juice squirted into his eyes, was admitted to a hospital in Sydney suffering from loss of sight. It was found that his pupils were intensely dilated as if by atropine, and the effect was traced to Solandra growing in his garden.

The property of dilating the pupil of the eye is common to all the tropeines, but this very valuable action is accompanied by other objectionable properties which vary with the different members of the group, and this makes the discovery of a new member of special interest, in the hope that the deleterious qualities may be less or entirely absent.

The material for this investigation was kindly supplied by Mr. Maiden from plants growing in the Botanic Gardens, Sydney.

First, in order to obtain a general idea of the composition of the leaves, a complete proximate analysis was made by the method of Dragendorff.

The following tables show the constituents of the leaves :—

The fresh leaves—

Water removed by air-drying	78·40 %
Water removed at 100° C.	2·145
Mineral constituents (ash)	3·125
Organic constituents (by difference)	16·33
	100·00

The air-dried leaves—

Water at 100° C	9·93
Mineral constituents (ash)	14·46
Removed by solvents	34·34
Cellulose, lignin, etc. (by difference)	41·27
	100·00

The air-dried leaves contain :—

i. *Extracted by petroleum spirit*		3·692 %
Volatile oli	0·305 %	
Resins	0·257	
Chlorophyll	0·880	
Fixed oil	2·250	
ii. *Extracted by ether*		2·582 %
Fixed oil	1·211 %	
Water sol. portion	0·519	
Chlorophyll and resins	0·852	
iii. *Extracted with alcohol*...		8·330 %
Glucose	trace.	
Saccharose	2·88 %	
Alkaloid	0·11	
Tannin	4·30	
Phlobaphene	1·04	
iv. *Extracted with water*		19·740 %
Mucilage	4·13 %	
Glucose	5·44	
Saccharose	4·71	
(Undetermined)	5·46	
		34·344 %

Extraction of the alkaloid.—In a preliminary trial on a small quantity of leaves, there was obtained evidence of the presence

of an exceedingly active and poisonous alkaloid. In order to obtain an amount sufficient for further investigation, 1000 grams of leaves were exhausted with boiling water faintly acidulated; the solution was evaporated to dryness, and its residue extracted with alcohol in a Soxhlet extractor. The alcoholic solution containing all the alkaloid was then distilled in vacuo, the residue dissolved in water, and the solution filtered. This clear aqueous solution was acidified with H_2SO_4, and shaken out, first with amyl alcohol, then with ether, till nothing further was removed. The residual aqueous solution was then rendered alkaline and shaken out with ether. On evaporation of the solvent 0·865 gram of impure alkaloid was obtained.

Purification.—The crude material was dissolved in slightly acid water and shaken with ether in alternately alkaline and acid solution; the ethereal layer was separated and the shaking out repeated till no further residue was observed on evaporating the solvent. The total ethereal extract now yielded 0·39 gram of alkaloid. The aqueous solution was further shaken out with chloroform, and from this, after removal of the solvent, was obtained a residue of 0·188 gram. This residue was found later to be non-alkaloidal.

It was noticed, when the solutions were warmed to volatilise the solvent, that a strong odour was evolved resembling that of nicotine or conine, and suggesting the admixture of a volatile alkaloid.

To test this point the ether residue (0·39 gram) was dissolved in acidulated water, then made faintly alkaline and distilled in a current of steam. The distillate was strongly alkaline; but when neutralised and evaporated to small bulk it gave negative results in every case on testing with all the ordinary alkaloid reagents. The same process was likewise gone through with the chloroform residue (0·188 gram) and again the distillate was found to be non-alkaloidal.

From this it may be definitely inferred that no volatile alkaloid is present, and that the distillate is strongly alkaline by ammonia formed probably from the amidenitrogen in the plant.

The liquid left in the retort from the first distillation contained the whole of the alkaloid, which was recovered by shaking out with chloroform, and now weighed 0·164 gram. This much purer material was used for the subsequent examination.

Chemical properties.—The material as obtained in the above manner is a yellow viscous mass, which becomes quite fluid on gently warming. It is quite free from odour, even on heating. The solubility in benzene and ether is slight; it is very soluble in chloroform and in alcohol; but slightly soluble in water, giving an alkaline solution and possessing a bitter taste. All attempts to crystallise it failed, hence the difficulty of its purification.

The aqueous solution gave well marked ppts. with the following alkaloid reagents:—I in KI, picric acid, phosphotungstic acid, tannic acid, $AuCl_3$, $PtCl_4$, and $KI.HgI_2$. In Vitali's test a bright purple colour was obtained.

Phenolphthalein is not reddened. $HgCl_2$ 5 % in alcohol, gives a white precipitate (atropine gives yellow, and red on warming). $PtCl_4$ gives, in a strong solution after standing some time, perfect yellow cubical crystals, which decompose at 170°C. $AuCl_3$ yields two kinds of crystals, transparent colourless cubes and octohedra, mixed with irregular yellow crystalline masses. With picric acid, radiating groups of prisms are obtained showing many curved and feathery crystals.

10 mgms. of the alkaloid were next hydrolysed with barium hydroxide, and on separation of the products of hydrolysis there were obtained, first, an acid which crystallised on evaporation in long thin needles having a melting point of 106°C ; and secondly, a basic substance which resembled the original viscous yellow alkaloid in appearance, but formed a very different platinum salt. The quantity was not sufficient to decide whether the base is tropine or oscin. From 10 mgms. of the alkaloid were obtained by hydrolysis 35 % of an acid possessing the identical m. point and properties of atropic acid, and 30 % of an uncrystallisable base. This ratio of acid to base is equal to 1·17, which is the exact theoretical ratio of tropic acid to tropine in the well known atropine group.

Physiological properties.—Dr. H. G. Chapman has carried out for me a number of experiments on rabbits, frogs, and dogs. Introduced into a rabbit's eye, 0·1 mgm. of solandrine causes full dilatation of the pupil, with loss of the light reflex in twenty minutes. The inequality of the pupils may be noted until the fourth day after the instillation.

On the frog's heart solandrine possesses the property of paralysing the receptive substance for the endings of the vagus nerve. After the application of solandrine, stimulation of the trunk of the vagus no longer abolishes or interferes with the rhythm of the heart. Stimulation of the crescentic junction of auricle and sinus also fails to arrest the beat.

In the dog the injection of 8 mgms. of solandrine abolished the secretion of saliva and tears, accelerated the rate of respiration, increased the rate of the heart beat, and raised the blood pressure. Stimulation of the peripheral end of the divided vagus further failed to cause any alteration of the rhythm of the heart beat or the height of the blood pressure.

In these respects solandrine exhibits the action of the atropine group of nerve and muscle poisons.

Summary and Conclusions.—The alkaloid is proved to belong to the atropine group (1) By its chemical constitution: it splits up, on hydrolysis, into a base and an acid in precisely the same ratio as tropine to tropic acid in atropine and its isomers. (2) By its chemical and physiological properties: it gives Vitali's test in common with all the members of this group; it produces complete dilatation of the pupil, and all the effects characteristic of the natural tropeines on the heart, the secretory glands and the blood pressure.

It exhibits the following differences in properties from the well known tropeines:—phenolphthalein is not reddened by the solution; alcoholic solution of mercuric chloride causes a white ppt., atropine gives red, hyoscyamine gives yellow, and hyoscine a white ppt.; the platinum salt crystallises in small cubical crystals, whilst atropine is monoclinic, and hyoscyamine triclinic; the aurochloride crystals also are quite different.

Solandrine more closely resembles hyoscine. Both are thick syrups in the free state, yield white ppts. with alcoholic mercuric chloride, and form cubical platinic chlorides. It differs from hyoscine in its aurochloride, in not reddening phenolphthalein, and by the fact that it yields atropic instead of tropic acid when hydrolysed.

Though much still remains to be done in working out the exact constitution of the alkaloid, I consider that the above results afford sufficient evidence of the existence of a new tropeine alkaloid in *Solandra lævis*, for which, therefore, the name Solandrine is proposed.

I have to express my best thanks to Professor Anderson Stuart for the numerous facilities he has kindly afforded me in carrying out the above work in his laboratory

Corrigendum.—I take the opportunity of drawing attention to a necessary correction in my paper on 'The Stinging Property of the Giant Nettle-tree' (These Proceedings, 1906, xxxi., p.530). In the table on p.536 the inorganic matter has been inadvertently included twice; the table should read as follows:—

	On fresh leaves.	On air-dried leaves.
Extracted by Petroleum spirit	0·60	2·56
Ether	0·33	1·41
Absolute alcohol	0·88	3·74
Water	2·47	10·60
Total extracted by solvents	4·28%	18·31%
Moisture by air-drying	76·65	
,, and vol. acids at 110° ...	3·11	13·30
Inorganic matter = ash	3·60	15·42
Cellulose, lignin (by difference)... ...	12·36	52·97
	100·00	100·00

Also on p.535, line 24, *for* 4·74% *read* 3·74%.

THE GEOGRAPHICAL SIGNIFICANCE OF FLOODS, WITH ESPECIAL REFERENCE TO GLACIAL ACTION.

By E. C. Andrews, B.A.

(Plates xliv.-xlv.)

Introduction.

The finding of a principle is necessary for scientific advancement: with its clear understanding one marvels that the explanation of certain natural phenomena has been concealed so long. Nevertheless, although every natural law so far discovered is excessively simple in its operation, a comprehensive, as against a microscopic, view is needful, otherwise the grand simple and central fact may be missed in the maze of attendant details. The case is analogous to that in which the names of territories or continents printed in large type across maps are missed owing to the focussing of the eye on the minute details; similarly, novices experience difficulty in grasping the principle of the steam engine when confronted, for the first time, with a near view of the subsidiary parts. Apparently the case of stream-development is no exception. The belief that streams have, in the majority of instances, carved their containing valleys; that sea-currents have moulded the shoreline curves; and that glaciers have, to some extent at least, modified the preglacial valley-contours, is very widely entertained; nevertheless the significance between extreme flood and drought stages appears to have been strangely overlooked. The great difference in the work performed during these extreme phases of stream-action may have been frequently admitted, but the application of the principle has not been seriously considered. Thus, are we to consider the work of the normal stream or that of the mighty flood as our unit in estimat-

ing stream corrasive effects? Whichever is taken, the problem resolves itself into a summation of excessively numerous and relatively small activities. Is the valley the summation mainly of many thousand flood-thrusts; or is it rather the "integration of an infinity" of normal and drought stream effects?

If now it can be shown that floods of great strength produce characteristic and important forms in valley channels; and furthermore that these characteristic and dominant forms remain virtually unaltered until the return of an equally great, or still greater, flood, we should obviously feel inclined to assign by far the more important corrasive effects to flood-action.

Moreover, if a study of very small flood-channels, such as roadside storm-gutters and brooklets; of larger examples such as those of rivers and shorelines; and of mighty channels also such as Alpine and Sierran cañons, channels undoubtedly subject to former intense glacial action—if a study of these, we say, should reveal, in each type, the presence of peculiar and prominent contours all of similar shapes; and not only so but a similarity of situation in each case for such contours, the difference in size being the only essential point of distinction; and furthermore the size being in direct proportion to the size of the various floods—then indeed we might reasonably feel much more strongly supported in our contention. We would be prepared, of course, to admit the corrasive properties of streams in their normal or even in their drought stages; nevertheless, since the flood-contours are only seriously modified, or possibly effaced, by other deluges, land-reduction would appear to be virtually accomplished by gread flood-corrasion.*

Thus if this simple principle be grasped, it will at once be seen how geographical methods will be revolutionised. For seeing that shorelines, stream-developed valleys and fiord-contours are the work of comparatively Titanic forces, it would be useless for one to study the methods of the harmless drought-stricken

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* Similarly for land-reduction by wind-action, the work of the great windstorm should altogether overshadow the effects of the intergale and the zephyr stages.

streams in order to appreciate the real shock of attack by which the land-contours had been carved. He who would see the true state of affairs must watch the Titan delivering his heaviest blow. Not that the succeeding pigmy-streams are incapable of continuing the work started by the giant, but merely that, while yet they are occupied in obliterating the Titan's marks, he again returns and carries on his former work of reduction.

The clear conception of the fact that shorelines, valley-floors, and fiord-contours result from the action of successive mighty floods, would put to rest many disputed points in glaciation and peneplanation; for it would at once be observed that drought streams slumber peacefully among the wreckage produced by the floods. So enormous were the weapons with which the giant streams armed themselves, and so flat were the grades they produced, that all the energies of normal streams or glaciers are utilised in merely filling up the holes resulting from such Titanic attack, or in forming lakes to surmount the masses of débris dropped here and there in the bed of the stream, upon the retreat of the great flood.

So simple was the principle that many workers appear, tacitly, to have admitted it; nevertheless they would not perceive its main significance. To Dr. G. K. Gilbert (17,*a* pp.89-90) belongs* the honour of having first, in 1883, clearly enunciated the principle as it applies to ordinary streams and coastlines. Yet even that acute and philosophic geologist hesitated to apply his own† far-reaching discovery to glacial studies.(17)

The present paper is an attempt to throw further light on Gilbert's principle by a comparison of observed small effects, such as one sees in storm-gutters, with the grand contours obtaining along large streams and glacial channels.

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* GILBERT, G. K.—Quoted at length later (p.800). The idea had occurred independently to the present writer in 1905. See ANDREWS, E. C. (*postea*). Dr. Gilbert's paper was not read by the writer until 1907.

† Dr. Gilbert in a letter to the writer (August, 1907) states that this idea came independently and contemporaneously to both J. W. Powell and himself.

Causes leading to present statement.

The writer was led to apply Gilbert's principle as the result of a short visit to the Lakes and Sounds of South-Western New Zealand in 1902-1903. During that trip a number of topographic forms, totally unlike those of non-glaciated Australia, had been observed. For a time no solution could be found to the problem. At this juncture a glacial note(9,*a*) and a letter were received from Prof. W. M. Davis. So simply stated were these notes that no doubt existed in the writer's mind as to "glaciation of preglacial valley contours" being the key to the problem. At a later date the writer(1,*a*) was led to announce the "Flood Hypothesis" to account for the peculiar forms exhibited by the sounds and associated lakes and cañons. The stagnation of present-day glaciers in Alaskan fiords; the overriding of glacial débris by the same ice-masses, and the lack of corrasive power exhibited by Alpine and other glaciers, all seemed explicable on this assumption of former ice-flood action.

Stream-studies were then entered upon in some little detail. Along gutters, floods were observed to excavate holes almost identical in shape with those of typical cirques, sound and lake-basins, as also to glacial cañons. Pronounced stagnation during drought or interstorm (flood) periods was noted. From these attention was directed to incipient cañon-contours, then to brooklets, brooks and rivers. In all, similar and similarly situated forms were observed. In every instance basins were seen to have been excavated at points of marked convergence; at points of weakness; and also other points of heavy thrust in the large or small cañons. The valley-basins were observed to possess reversed grades downstream: in short, they were miniatures of the fiord- and lake-basins existing in regions of recent intense glacial action.

One was thus led, step by step, to reason from flood-effects in small channels such as roadside gutters, incipient cañons and brooklets, to those in basins and spurless cañons of intensely glaciated regions. In a word, knowing that certain gigantic and remarkable "facts of form"—to wit, cirques, fiord- and associated

lake-basins, spurless cañon-walls, and hanging valleys—always and only obtained in glacial regions; knowing also that these contours are duplicated in miniature along river flood-channels (allowance being always made for the stage of development attained); knowing moreover that these forms are again duplicated, but still less in size, along roadside gutter flood-channels, these last-mentioned forms being, by direct observation, undoubtedly the product of floods; and, finally, knowing that ice- and water-streams are somewhat analogous,(31) in general aspect; might not all these contours be interpreted as the early attempts of floods, varying in magnitude, to cause approximation of their channel bases to sea-level?

An analogy drawn from botanical studies may not be irrelevant in this connection. No one has seen any individual forest monarch in all its successive stages of sprouting, maturity, old age, and advanced senile decay, yet, even were the testimony of history outside his own experience withheld, no observer could doubt that each and every forest king possessed such stages of development; in the first place because the forest abounds with individuals representing all stages of growth and decay, and secondly, because each year one sees the birth, growth, decay and death of plant "annuals," these varying from the forest kings only in points of size and longevity. The observer simply grasps clearly the life-stages of the "annual," and then, from these small forms, infers the life-history of the greater.

To the observant, it is thus also with the small roadside gutter-basins—the product of severe storms—the Amazonian channel-basins, and the fiord-basins, the latter expressing the summation of huge flood-thrusts.

The writer's best thanks are due to H. Hoggan, Esq., for the drawing illustrating the contours produced in a creek-base during a flood at Bouralong in New England, N. S. Wales.

Some recent Advances in Stream and Glacial Studies.

At this stage it may be advisable to note certain recent advances in stream and glacial studies, all throwing light upon

the subject under discussion. Between the periods 1874 and 1883, the scientific epics of Dutton,(10) Gilbert,(17,a,b) and Powell(23) were produced. So clear is Gilbert's statement concerning flood-action that one marvels at the persistence of the glacial controversy.

For the benefit of all, Gilbert's(17,a,pp.89-90) grand announcement is here reproduced.

"The explanation of these inequalities depends in part on a principle of wide application, which is on the one hand so important and on the other so frequently ignored that a paragraph may properly be devoted to it, by way of digression. There are numerous geologic processes in which quantitative variations of a causative factor work immensely greater quantitative variations of the effect. It is somewhat as though the effect was proportioned to an algebraic power of the cause, but the relation is never so simple . . . . and it gives to the exceptional flood a power greatly in excess of the normal or annual flood. Not only is it true that the work accomplished in a few days is greater than all that is accomplished during the remainder of the year, but it may even be true that the effect of the maximum flood of the decade or generation or century surpasses the combined effects of all minor floods. It follows that the dimensions of the channel are established by the great flood and adjusted to its needs.

"In littoral transportation the great storm bears the same relation to the minor storm and to the fair-weather breeze. The waves created by the great storm not only lift more detritus from each unit of the littoral zone, but they act upon a broader zone, and they are competent to move larger masses. The currents which accompany them are correspondingly rapid, and carry forward the augmented shore-drift at an accelerated rate. It follows that the habit of the shore, including not only the maximum height of the beach line and the height of its profile, but the dimensions of the wave-cut terrace and of various other wave-products presently to be described, is determined by and adjusted to the great storm.

"It should be said by way of qualification that the low-tide stream and the breeze-lifted wave have a definite though subordinate influence on the topographic configuration. After the great flood has passed by, the shrunken stream works over the finer débris . . . the smaller waves of fair weather construct a miniature beach profile adapted to their size. . . . Thus, as early perceived by De la Bêche* and Beaumont,† it is only for a short time immediately after the passage of the great storm that the beach profile is a simple curve; it comes afterwards to be interrupted by a series of superposed ridges produced by storms of different magnitude."

McGee's paper of 1883(21,*a*) is a remarkable statement. Attention is drawn therein to typical glacial profiles, and a great case for glaciation is here unmistakably stated.

Russell in 1889,(25,*a*) Cushing(6,*a*) in 1891, and Russell again in 1892(25,*b*) experienced difficulties in accepting the glacial explanation for certain cañon-contours. Especially were these difficulties experienced in attempting explanations of the moraine-overriding habits, and general stagnation of the Muir and other glaciers.

McGee in 1894,(21,*b*) when considering the mechanics of glaciation, Culver in 1895(5,*a*) and Reid in 1896(24,*a*) all record apparently anomalous phenomena, which, however, apparently admit readily of explanation on the assumption of former ice-floods.

The 'Great Ice Age,' by Dr. J. Geikie,(16) furnishes a grand summary of glacial knowledge up till 1898. Incorporated with this volume is a concise statement by Chamberlin of glaciation in North America.

The articles by Chamberlin(3,*a*,*b*,*c*) and Salisbury(26) throw much light on glacial mechanics.

In the illustrations accompanying Chamberlin's Reports, one sees repeated evidence of the shearing and overthrusting of ice-

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* Manual of Geology. Philadelphia, 1832, p.72.

† Leçons, p.226 and pl.iv.

layers in glaciers. This, by some observers, has been adduced as evidence of the incompetence of ice-erosion. Yet this is what one would expect from a study of ordinary streams. Every river has a down-stream motion; nevertheless, at almost every point, eddies are set up by reason of channel obstacles; and these eddies give rise to breaking and shearing of water-masses. Compare also the breaking of waves, the wave of translation, the undertow, the leaping of torrent flood-waters, and the violent dashing of the same around rocks and other channel obstructions. Notwithstanding this evidence of waste force, no engineer of repute would believe that such eddying and overthrusting of water-masses argued corrasive incompetence for that particular stream. On the contrary, these shearings reveal intense action which finds partial relief upwards by reflection. Dr. W. G. Woolnough, of Sydney University, in conversation with the writer, mentioned the action of a great flood witnessed by him in Fiji. So great was the rush of storm-water that, not only water-masses, but large stones were thrown high above the stream-surface by the tremendous force of the eddying current.

Gannett's "Lake Chelan"(13) apparently marks the commencement of a new era in glacial work. Fresh light is thrown on the problem by his descriptions and discussion.

Penck again, in 1899, as quoted by Davis,(9,a,p.319) stated the case for vigorous glacial erosion in the Alps.

Both Gannett and Penck have drawn attention to certain similarities existing between glacial and ordinary stream-channels.

It was, however, a comprehensive paper by Davis, in 1900,(3,a) which caused the Writer to become a "glacialist." As a result of meditation on the excessive simplicity of Davis's statement, the idea was entertained that the existence of a former great ice-flood would throw light on such apparent anomalies as present-day glacial stagnation, moraine-overriding by ice-masses, the peculiar appearance of drumlins, and other points.

Gilbert's contribution, in 1899,(17,a) marks a decided progressive move. To him we are indebted for the term "Hanging

Valleys," as also for an explanation of these peculiar forms. Russell and McGee had, still earlier, called attention to these contours. McGee had also supplied an explanation.

Matthes's report of 1899,(20) as also his topographic maps of Yosemite, are another valuable addition to our knowledge of Sierran glaciation, especially in connection with cirque-formation.

Johnson, in 1904,(19) summarised the main topographic points of the Yosemite. As a result of his excellent observations he he was led to announce a method of cirque-formation by forces acting along lines "curving sympathetically" with those of *bergschrunds*.

Tarr in various papers(27,*a*,*b*) called attention to the marvellous contours of the Finger Lake and other regions. His latest paper(12) contains very clear statements of the efficiency of ice as a rock-corrader.

Westgate, in 1905,(30) quotes a concrete case in which a later ice-visitation had, in the main, succeeded merely in aggrading the excavations made during an earlier glacial period. He, however, does not generalise from the observation.

Thesis.

The great flood is the main corrasive factor in peneplanation. A "flood" may be defined as that stream-volume which is competent not only to utilise the channel-base as a bridge for the transportation of the heaviest stream-material, but has enough residual energy to cut vertically into the live rock of its channel-base. All other stream-volumes are comparatively negligible as regards corrasion. Roadside gutters, brooklet, brook and river valleys, shorelines and glacial cañons have dominant shapes all similar and similarly situated.

Present-day fiord (and some cañon) glaciers should be inactive in their channels, with overriding of moraines.

On the assumption of a recent ice age, many contours may thus be predicted for glacial regions.

Types of Flood-Channel Contours.

For the sake of simplicity the order observed in the following channel-contour descriptions will be from smaller to larger.

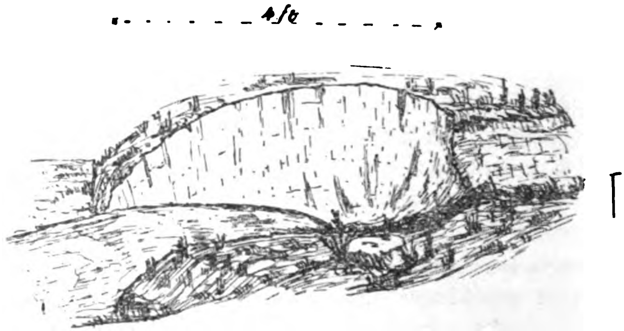

Fig. 1.—Basin formed in hard clay during heavy storm; Emmaville, New England. Note the aggradation by decrease of gravitative water-thrust.

1. *Roadside gutters.*—It must be understood at the outset that the contours here described refer to country tracks which have

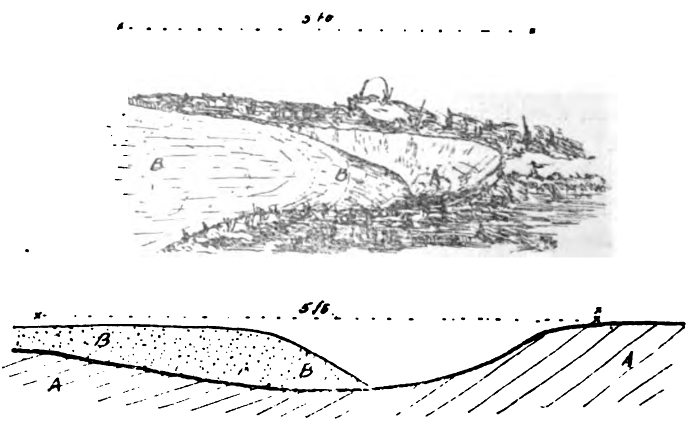

Fig. 2.—Small basin formed in hard clay at Tenterfield (New England) during heavy storm. Note the decrease of storm-water as shown by partial aggradation of basin. This figure throws much light on cirque and fiord-basin formations, also on drumlin and moraine distribution.

fallen into disrepair. The peculiar contours of these gutters are well known to be developed during severe rainstorms. The forms depend upon the material acted upon; this may be homogeneous and coherent; it may be soft basally and have a hard capping; or it may be soft above and hard below. The homogeneous and coherent structures alone will be here considered, as the reader may easily reason out the contours for the non-homogeneous structures from a knowledge of the forms produced in the simplest case. A disused foot, bridle or wheel-track in tenacious clay or rotten rock very frequently constitutes the

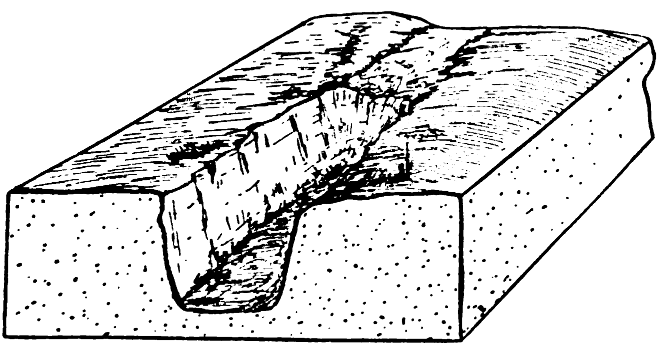

Fig. 3.—Trench with amphitheatrical (or cirque-like) head formed in hard clay during heavy thunderstorm. The trench originated in a basin, as shown in figs. 1 and 2; and the recession of the basin-head caused the long gutter with its straight sides and broad base. The figure illustrates a possible origin of fiord-basins.

original valley. These tracks may have been but a few inches deep and less than a foot in width. In regions subject to violent thunderstorms the valley, after several years, is probably from one to two feet in depth and has, comparatively, a very wide floor, straight or very steep sides, spurless walls, a fairly uniform grade broken every here and there by amphitheatrically-headed trenches, the amphitheatre bases existing in the form of basins, deepest near their upstream ends. Stream débris is commonly plentiful near the downstream end of the basins. Again, basins

are commonly located at rut-convergencies and immediately below local barriers or hardnesses such as rocks and tree-roots. Portions only of these gutters may consist of trenches such as those just described, nevertheless, where they occur, the smaller side-streams near the amphitheatrical heads are "hung up" over the main rut.

2 *Incipient Cañon-Contours.*—These interesting geographical features represent the more advanced stages of road-gutter, or similar valley, making. Very frequently they occur in decom-

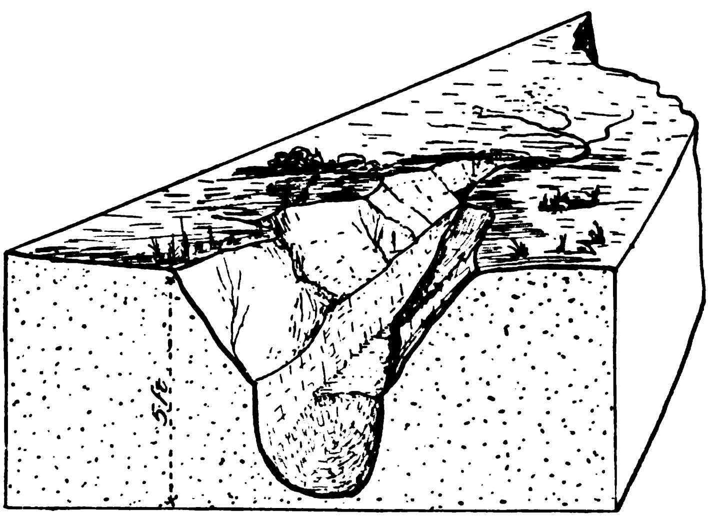

Fig. 4.—Incipient cañon formed by flood-waters at Uralla (New England). Note the double slope in the cañon. The lower valley showing basin, spurless walls, and U-shape in section marks the work of a very heavy storm. The upper portion of cañon shows ordinary spur-development. The lower contour shows a remarkable resemblance to glacial forms.

posed rock-masses, and they may, in a few decades, attain depths as great as 50 feet. They also afford striking examples of V-shaped valleys possessing well-marked overlapping spurs. Their origin, in New England, can be usually traced to the

action of floods along disused wagon tracks, or "tailraces"* used in alluvial mining. The largest examples known to the writer in New England are 50 feet deep, and the greatest age known is 50 years. But, whereas the ordinary road-gutter is wholly occupied by storm-waters, the bases only of the young cañons under consideration are so occupied. If attention be confined to the lowest portions only of these gulches there will be found basins, U-shaped sections, and stretches of channel-base rectilinearly disposed, all similar to those found along the gutters. This lower portion is that which is occupied by the heaviest storm-waters. Above these flood-channels one finds V-shaped valley-sections and the other characteristics of valley-slopes which have been determined mainly by weathering and stream trickles. It will be found also that hanging valleys occur along these lower portions in positions similarly situated to those along ordinary road-gutters.

The accompanying sketch illustrates contours of a tiny cañon at Uralla, New England. The observations here recorded deserve careful consideration, inasmuch as they throw considerable light on the characteristic contours of fiords and Alpine lake-regions.

3. *Brook and river-channel contours.*—These will be found to represent features very similar to those of incipient cañons. One or two distinctions may be drawn, however, between the types, whereas the flood-channel of the incipient cañon occupies a considerable fraction of the whole valley, the flood-channels of ordinary brooks and rivers generally occupy but an insignificant portion of their containing valleys. Again, the incipient cañon is but the product of a few years' stream-corrasion, and as such its features stand out plainly; whereas the ordinary stream-developed valley, representing, possibly, the action of streams during millions of years, has its contours softened and partially concealed beneath rock-waste and vegetation. Yet the frequent

* A "tailrace," in Australian alluvial mining, signifies a small channel situated below ground-sluicing operations, and employed as a "getaway" for the earthy material associated with the valuable minerals.

basins and broadly U-shaped contours are, in each case, found both similarly shaped and similarly situated.

Chamberlin and Salisbury (4,i.p.79) mention the occurrence of a basin at Fort Jackson, excavated by the Mississippi, 250 feet below baselevel. The authors do not state the occasion, or occasions, necessitating such powerful gravitative thrusts; whether obstructions, convergence of tributaries, or formation of small basin at convergence and later enlargement linearly by headward growth.

In ordinary stream-valleys also, freedom from débris often characterises channel-narrows, while aggradation marks channel-divergences.

In the discussion it will be seen how applicable all this is to the case of glaciation, whether considered as Alpine or continental glaciation.

4. *Glacial valley-contours.*—The magnificent descriptions of Davis, Gannett, Gilbert, Johnson, McGee, Penck and others, have made typical glacial valley-contours familiar to all readers.

In New Zealand one finds equally characteristic contours in Hall's Arm, Crooked Arm, Lake Te Anau, Milford Sound, and the Hollyford Valley.

The cañon floor is frequently terraced (19,22a), the terraces being subhorizontal and rising from one to the other by means of amphitheatres or cirque-like forms. For considerable distances spurless walls characterise the cañons, while magnificent cirques commonly form valley-heads. Small rock-basins lie at the feet of the cirques, while frequently low *cols*, U-shaped in section, lead to similar valleys across the divides.

The cañons of south-western New Zealand end in large rock-basins, sometimes 40 to 50 miles in length, their bases being as much as 2,000 feet below local or main baselevel. Moreover, these basins show reversed grades lower downstream, while tributary streams are well hung up above the main lake or sound floors. The following sketches, as also Plates xliv. and xlv., illustrate well these contours of formerly glaciated regions.

Such deeper basins occur at or near marked cañon-convergences, within walls of exceptional height and strength. Here, also, occur the finest hanging valley types. Very little morainic material is to be found in these steep cañons.

Fig. 5.—The Sentinel, Clinton Valley, N.Z., 3000 (?) feet above valley. A truncated spur, the truncation causing the hanging valley at A.

If, now, these forms be compared with those of ordinary stream-valleys, it will be seen that the cirques, lake- and sound-basins, spurless walls and flattish floors are all Brobdingnagian equivalents of the basins and narrows in the flood-channels of the various stream-valley types. In the one case the flood-channel occupies but a fraction of the valley, while in the other the glacier, or ice-flood, occupied almost the whole of the cañon. This point, I think, has been especially emphasised by Prof. W. M. Davis (9a, p.293).

It is, however, when comparing glacial cañons with the gutters produced by floods along disused roads, that the great resemblance to glaciated cañons is noticeable. In both cases the flood occupied either the whole or the greater portion of its valley.

Examples of Flood-action as observed by the Author.

The forms to be now described occur in the northern and eastern portion of New South Wales.

(a) Bouralong.—Here a creek, with a run of about two miles, flowed along a flat of tenacious clay underlain with heavy stones partly cemented together. A severe thunderstorm produced a rush of water which carved deep trenches and basins along the flat. In one case a trench eight feet deep, ten feet wide, and ten chains long, was cut by the stream. The cañon thus produced had straight sides, a flat floor, and hanging valleys. In another place a trench was cut showing terraces and cirque-like basins. The accompanying plan and sketch illustrate the occurrence.

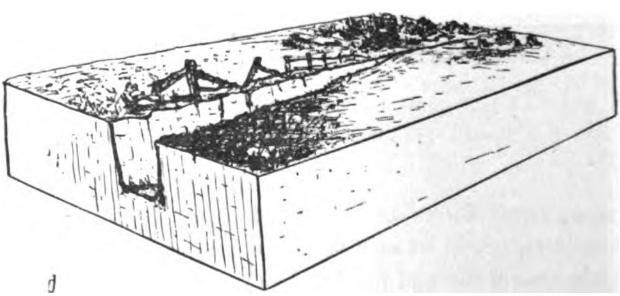

Fig. 6.—Trench formed at Bouralong (New England) during severe storm. Length of trench, 10 chains (220 yards); width and depth, 8 feet. Note the straight walls and the broad base. The trench was formed by recession of a waterfall originating in a marked acceleration of velocity caused by a channel-obstacle situated on a decline.

These long trenches were not excavated by a single convergent thrust, but commenced rather as small amphitheatres due to stream-convergence, or gravitative thrusts, determined by obstructions. The waterfall thus started quickly worked its

way backwards, leaving a deep trench and basins in its wake. Especially does this observation throw light on Alpine lake and sound basin-formation by ice-floods.

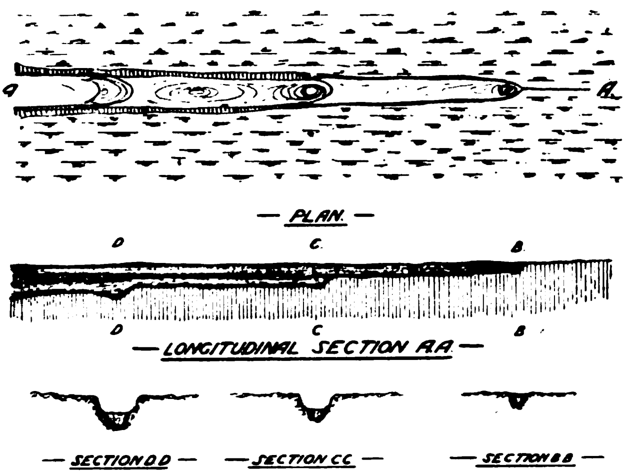

Fig.7.—Plan and section of a peculiar series of basins formed in hard clay, during a severe storm at Bouralong. The figure throws considerable light on the formation of cirques, lake-basins and cañon-contours. Drawing by H. Hoggan.

(b) Muddy Creek, Sydney.—This watercourse has a run of some two miles above the basin-form now to be described. During the "Dandenong Storm" in 1876, the creek carved out an amphitheatrically-headed basin some 20 feet below the local baselevel. The basin remained for some 20 years, when successive flood-action had succeeded in aggrading it.

(c) Hillgrove.—During the severe flood which visited New England in 1893, an angular block of granite, some 40 tons in weight, lying in the bed of a small watercourse, was carried two chains downstream by a heavy rush of water. Hosts of boulders, several hundreds of pounds in weight individually, were carried for great distances downstream. Succeeding floods have been

able only to partly override these boulder-heaps, without moving them.

(d) Schofield's Creek.—The marvellous work effected along this small watercourse during a severe thunderstorm has been described elsewhere by the writer (1,*b*, p.504).

These examples could be multiplied almost indefinitely by the reader. In all, the wonderful similarity of forms produced to those existing in glacial cañons is most pronounced.

The Action of Great Floods generally.

The chief phases of flood-action have been described elsewhere by the writer(1,*a*,pp.34-41). Several additional facts of observation may be here noted, since to those unaccustomed to the phenomena of great floods, much difficulty attends the conception of ratio of work to increase of velocity as observed by streams. One easily repeats the formula "Power of transportation varies as the sixth power of the velocity," but the significance of this law can only be properly appreciated by the individual through personal observation. In this connection Dr. W. G. Woolnough, of Sydney University, described to the writer a most severe rainstorm in Fiji during which boulders were swept along a creek bed with such force as to leap high out of the water. In such cases, also, whole masses of water are sheared and driven high above the flood-level. Again, the placid water above the Niagara or Zambesi Falls is the same water which, a little later, rushes in its mad career below the falls. The former may be considered the normal stream, the latter a furious flood, and this simply by reason of greatly increased velocity. In the ordinary stream it is the volume of the flood which produces the increased speed, whereas at Niagara and the Zambesi it is the steepened grade which accelerates the velocity.

Again, during floods torrent-narrows are also scoured, and the débris swept thence into valley-divergences. Shearing and eddying of water-masses, as also the scouring of stream-narrows, find their analogies in glacial action. As such shearing and eddying are at a maximum during the period of greatest efficiency

of a river-flood, we may extend the same reasoning to the ice-flood; and thus conclude that great ice-shearing and cañon-scouring should mark the period of greatest glacial intensity.

On the other hand, the great flood is after all but a study in limitations, for at its very height it aggrades as well as corrades. It cuts vigorously on one side and forms deposits opposite the cutting curve. So does the glacier. But in the latter case the flood was not confined to the cañon base. At times the whole lower cañon might form its cutting side, and the aggrading portion might have to be sought high up on the cañon sides or in a marked valley-divergence.

Recession of high-water mark.—With the least recession of the flood comes the dropping out of the heaviest boulders, that is, those which for their moving taxed the utmost strength of the giant. The subsiding water now no longer possesses the energy—gravitative thrust—to use the reversed grades as bridges for transportation of stream débris : forthwith it commences to build out deltas into the depressions.

Action of smaller floods.—The smaller flood works over the material left by the great flood, and provides therein for itself a channel similarly shaped to that of the maximum flood. This follows immediately either from direct observation or from a study of the mechanics of flowing water. It cuts basins and other channel-contours now not in rock but in storm-débris, as its strength is incompetent to deliver blows equally telling with those of its predecessor. The largest flood-boulders are not shifted, but merely overriden wholly or in part.

It cannot, however, too frequently be stated that smaller floods are quite capable of accomplishing peneplanation themselves, but the great flood is of such common occurrence that the forces of weathering have not time enough—during interflood periods—in which to promote rock-decay whereby the smaller flood might accomplish rock-basining.

5. *Shoreline forms.*—The recent "incisive" account of shorelines by Gulliver,(18) as also the classics of Gilbert(17,*a*,*c*) and others enable us to perceive the similarity of shoreline and

ordinary stream-channel forms. Consider, in this connection, the subaqueous strip varying, according to the depth of the water, from a mere ribbon to a band several miles in width, and "curving sympathetically" with the shoreline. The main activities are the waves, tides, and resultant currents. On one side the heavy wind limits the seaward extension, while on the other the shoreline acts as a wall to the (shore) stream. The action of this current is to form a bridge alongshore over which to transport material. The heaviest floods (storms) can utilise low flat grades as bridges which succeeding smaller floods (or gales) find too flat, and which straightway they proceed to aggrade. Again, the heaviest "gale of the generation or century" can work havoc on the cliffs by transport of heavy boulders. With the recession of the great gale these are dropped, and succeeding heavy but weaker gales can merely override, but not move, these boulders. Thus the deadly weapon to the cliffs in the hand of the great gale has become a veritable buttress to the cliffs during the period of lesser winds

Significance.

It may seem a simple matter to accept Gilbert's principle, namely, that the great flood accomplishes the main portion of stream-work, nevertheless it is almost safe to state that its proper understanding would lead to results almost, if not quite, as remarkable as those which have followed on the proper apprehension of other fundamental geological conceptions. For the light thrown thus on glacial methods is almost incredible at first glance, while the value of ice-action studies in any discussion as to methods of peneplanation is, in turn, strikingly apparent. And for this purpose, when discussing stream-channel grades, it would appear advisable to consider the channel-contour rather than the surface of the waterbody contained therein.

Prof. Davis has by letter pointed out to the writer that the term "grade" as applied to streams should have reference more correctly to their surface-levels; for the purposes of this note, however, interest centres around the channel-contours them-

selves. In youthful dissection one finds the greatest discordances in these channel rock-slopes; while in extreme old age the grades are almost perfectly harmonious: in other words, in areas of little or no relief gravitative thrust is reduced to a minimum.

Believing firmly in Gilbert's principle, the writer has ventured to announce the existence of certain land-contours the world over on the assumption of such principle. Contours in glaciated regions have been specially selected for consideration because of the various conflicting views entertained as to their origin.

A. *Glacial phenomena.*

(a) Fiord regions.—Alaska, New Zealand, Norway, Patagonia.

The following deductions are based partly on the belief that in these regions fierce but short-lived glacial floods acted along profound stream-formed cañons, and, in part, also, on the belief that glacial action is analogous to that of water streams. This conclusion is based on a comparison of glaciated and non-glaciated western New Zealand. The contours expected in glaciated areas on such analogy would be much as follows:—

i. Cañons of profound depth with comparatively wide and flat floors.

ii. Rectilinear walls in part. Compare Fig.3 illustrating roadside gutter-development during floods whereby deep straight trenches are excavated.

iii. Floors of cañons interrupted frequently by terraces possessing, approximately, amphitheatrically shaped heads. Compare Figs.4 and 7.

iv. Cañons terminating frequently in magnificent cirques. See Figs.2 and 3.

v. Cirques or, at times, precipices under smoothed cols.

vi. Basins at feet of cirques with reversed grades lower downstream. Compare with Fig.2.

vii. Cañon floor-grades interrupted by basins at various points:

(a) At marked cañon-convergences, especially where the main valley is but slightly larger in cross-sectional area than either of ts feeders.

(b) Cañon-narrows between exceptionally high and resistant walls.

(c) Areas of heavy thrust joining points of marked cañon-convergence, or several points of maximum gravitative thrust.

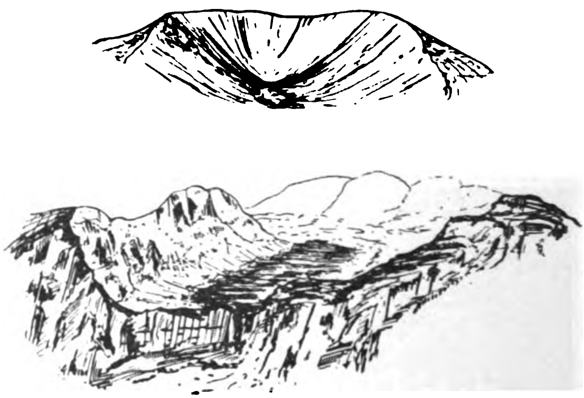

Fig.8.—Cirque-formations. Compare with figs. 1, 2, and 3.

To this case the writer would direct special attention, as thereby main fiord-excavation is probably explicable. And, at a glance, it will be seen that this is but a logical conclusion from a study of an example as depicted in Fig 6.

The trench depicted in Fig.6 was formed by the establishment of a point of heavy gravitative thrust downstream. This formed a marked discordance of grade; and the trench resulted from the recession of the initial waterfall. The higher the waterfall and the greater the water volume, the greater the gravitative thrust, that is, the deeper the basin excavated.

Now in a preglacial cañon we have, say, a marked cañon-convergence. A local basin is thus formed by the great ice-flood. Upstream another marked convergence occurs, causing a heavy down-cañon thrust. In seeking to harmonise the grade broken by the downstream ice-convergence, the ice-floods of the feeding cañons cause the basin-head to retreat upstream as far as

the marked upper cañon-convergences. Above these points basin-formation might progress but slowly.

Fiord-, and associated cañon-, basins should be carefully studied with this idea in view. Our only hope lies in studying these analogies, for we have ascertained, both by direct observation and the mechanics of flowing water, that the drought-stream is unable to utilise the flood-stream grade as a working slope: we cannot hope then, in the near future, to witness another ice-flood.

viii. Cañon convergences characterised by absence of morainic débris.

ix. Great deposition of débris below and near the basin-mouths. If the latest flood were enormous, so much freer from débris would the basin be; if a succession of smaller floods should follow, the tendency would be to fill the basin. The more nearly comparable these later floods should be, in point of size, to the large flood producing the basin, the farther down the basin would the débris be forced, leaving the head free and deep. Absolute incompetency to transport would result in delta-forming at the basin-head—in a word, the gravitative thrust would be zero below the local base-level. Compare in this connection Figs. 1 and 2.

x. Hanging valleys associated with fiord-basins. If the fiord basin result from ice-thrusts along converging cañons arranged symmetrically to the axis of the main cañon, then the hanging valleys may occur developed equally well along either side of the cañon; if the converging cañon axes be unsymmetrically disposed with respect to that of the main cañon, then along that side of the fiord or cañon facing the resultant ice-thrust one should expect marked undercutting of walls, with development of correspondingly grand hanging valley examples. Hanging valleys may also be formed by the processes described in ix.

xi. A marked inactivity of glacial-action at cañon-divergence (ice-diffluences).

xii. The glaciers succeeding to a period of intense glacial activity would confine their work to aggradation. The glaciers, therefore, which now occupy fiord-basins will be stagnant, over-

riding the old flood-moraines: in a word, by analogy with ordinary stream-action, they will be found hopelessly incompetent to effect corrasion of their beds.

Thus is deduced a most significant truth that, while present-day glaciers may certainly be studied to great advantage with a view to ascertaining methods of ice-motion on slopes, the work of the recent ice age glaciers cannot be appreciated by such study alone. On the contrary, unless one has a firm grasp of Gilbert's principle, the study of present-day glaciers would actually tend to cause disbelief in the competency of any ice-mass to efficiently corrade its channel. Experiments should be conducted in small stream-formed cañons by forcing strong ice-streams along the same for a considerable period. The removal of the ice should then reveal contours such as those just described.

Application.—1. New Zealand: Milford Sound. The convergence of Harrison Cove cañon with the main valley occurs near the Sound-mouth. Several miles higher up is the marked convergence of the Arthur and Cleddau cañons. Probably a basin was formed by the gravitative thrust at Harrison Cove mouth. This basin-excavation was continued upstream by the heavy ice-rush resulting from the marked convergence of the Arthur and Cleddau glaciers. This trough, in the line of fiercest thrust, is, as we should expect, free from morainic material: in fact, the trough itself demonstrates corrasion as opposed to aggradation. The marked shallowing of the main Sound outlet, as revealed by hydrographic surveys, indicates either "dumping" of material here or a slackening off, during the ice-flood, of rock-corrading power. Deltas now occupy the lower portions of the Cleddau and Arthur Rivers. These represent the action of insignificant postglacial water-streams. The resultant set of the former monstrous glaciers of the Arthur and Cleddau cañons was, approximately, to the north-west; therefore the northern wall of Milford should have been specially selected for attack. Undercutting forces would here be at a maximum, and hanging valleys would be correspondingly well "hung up": this is the actual state of affairs at Milford.

Examples almost equally as striking as those of Milford are to be found in Smith's Sound and Hall's Arm. Preservation Inlet,

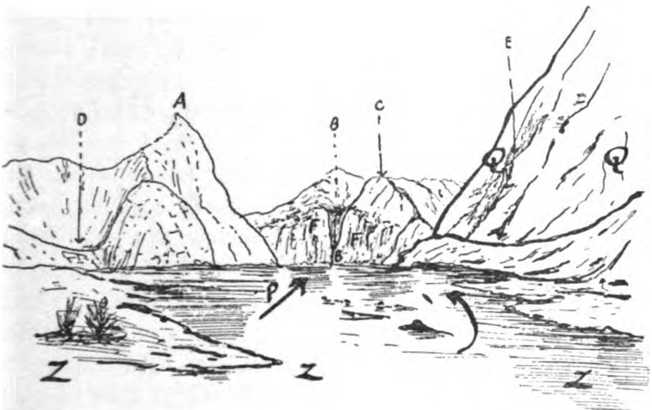

Fig. 9.—General view of Milford Sound from convergence of Cleddau and Arthur cañons.

The major thrust (P) has been directed against the right hand (northern) wall, as shown by marvellously undercut walls, FF and QQ.

A, Mitre Rock; 5,600 feet.

B, Sterling Falls (Hanging Valley); 504 feet.

C, The Lion Rock: 4,300 feet.

D, Sinbad Valley; 5,000 feet deep.

E, The lip of Bowen Falls; 550 feet (caused by enormous undercutting of wall QQ).

FF, Straight wall; 2,500 feet high. Sound 1,500 feet deep under points FFB.

The Sound appears to have commenced by baisining near B, and then carried backwards to ZZZ by recession of ice-fall and marked cañon-convergences.

(Pl.xlv.) on the other hand, exhibits cañon-divergence rather than convergence. Here, then, one would naturally look for islets as evidencing much reduced power of scouring.

2. Norway.—From photographs of Norwegian fiord-scenery one would expect to find a close association of dense rocks, straight

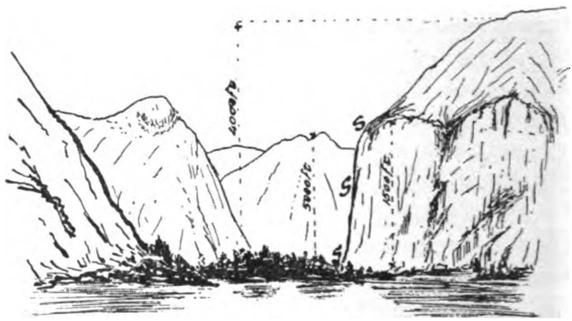

Fig. 10.—The Arthur River at its junction with the Cleddau. The wall SSS marks the actual former glacial flood junction. Note the marked undercutting of cañon walls.

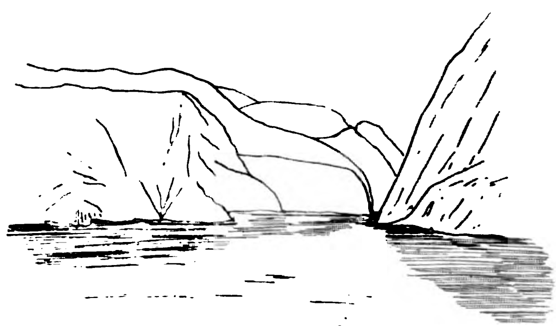

Fig. 11.—Sketch of Dusky Sound contours, New Zealand. Note the truncated spurs.

walls, marked cañon-convergence, and development of hanging valleys in the fiords of profound depth, such as the Sogne example is reputed to be. One should look for the long "deeps" to "join hands," as it were, from point to point of marked cañon-convergence. Each great convergence, or sudden narrowing, produced a basin which was continued backwards until it merged

into that higher up stream. We should thus even look for irregularities of depth from point to point in individual basins (fiords), especially at convergences and narrows.

All broads and divergences, as opposed to cañon-narrows, might be expected to hold less profound fiord-basins; in fact, one would even expect to find islets amid such surroundings.

3. Alaska.—The remarks made concerning New Zealand and Norway would also apply equally well in this locality. The Muir and Melaspina basins are, doubtless, associated either with marked cañon-convergences, by cañon-narrowing lower down stream, or other points indicative of heavy gravitative thrust.

These brief notes may serve to indicate the writer's general opinion concerning fiord-basins. Of course it is very possible that the glacial floods were not equally persistent in all fiord lands. Each district must be considered separately. Thus, suppose that a severe, or a record, ice-flood marked the last visitation in New Zealand, while a comparatively weak flood marked the Northern Fiord Ice Period. Then, in New Zealand, one would expect clean troughs (fiord-basins), while in the north he would expect heavy morainic deposits in the lower ends of the basins.

Compare figs. 1 and 2.

(b) *European Alps, Californian Sierras, the New Zealand Alps, and similar geographic regions.*

1. New Zealand.—Similar topographic contours might be expected in these localities to those obtaining in the fiord-regions; the main difference being that the fiord-contours are referred to main baselevel, while those of the Sierras and Alps are referable to higher temporary baselevels. Thus, Lakes Wakatipu, Wanaka, Te Anau, Hawea, and Manawapouri in New Zealand, have contours almost identical with those of the fiords on the opposite side of the range; the lake-surfaces, however, are generally 1,000 feet above sea-level. Hanging valleys and lake-depths are, apparently, not so pronounced as in fiords. This is doubtless connected with the heavy precipitation to be found in fiord-regions. In New

Zealand, while the fiord-region gets from 150 to 250 inches of moisture per annum, Lakes Wakatipu and Te Anau probably do not exceed 60 inches. A comparable precipitation probably obtained in the Ice Age, since no earth-movements of note appear to have taken place here in postglacial time.

2. Sierras.—A magnificent set of photographs illustrating geographic contours in the Canadian Rockies has been presented to the writer by A. O. Wheeler, of Calgary; and these shew forms identical with New Zealand Alpine types.

It is more than possible that the grand cañon-contours of the Sierras are associated with marked cañon-convergences, or that basins (lakes) have been formed by corrasion at marked convergences, and lengthened by gravitative thrust of the upstream glacier in its attempts to harmonise the cañon-grades. Hanging-valleys, sheer precipices and spurs shrivelled up to the main cañon-wall should be studied in connection with known direction of resultant thrusts from cañon-convergences. Lake Chelan appears to be a remarkable study in structural strength, allowing of profound preglacial narrows; of cañon-convergences with trough (lake) development by reason of headward retreat of heavy ice-falls initiated by some downstream cañon-convergence. Mono Lake region also appears to be a study in resistance or differential strength.

Cirques, also, probably arise in the main from the plunging action of floods, as exemplified by ordinary stream-action. Associated *cols*, when present, should always be examined in this connection to discover the catchment area really belonging to a cañon during the Glacial Period. Willard D. Johnson, however, in a brilliant note (19), suggests that cirque-corrasion is progressing now along lines "curving sympathetically" with the *bergschrund*. All such localities should be studied in connection with the provisions of the Ice-Flood Hypothesis.

One point which must not be lost sight of in this glacial study is, that intense ice-action, as water-action, is extremely localised. More misconceptions appear to have arisen from an oversight of this fact than any other. With streams seeking the baselevel,

the points of heavy gravitative thrust are the major discordances of channel-grade, howsoever initiated. Now, from considerations of earth-relief these are seen to be common only in Alpine or similar regions where torrent-tracks and marked cañon-convergences abound. Glacial contours should therefore be expected to reveal their magnificence in such regions, and be reduced almost to vanishing point when traversing regions of gentle relief.

We shall see how applicable all this is when discussing corrasion by an ice-sheet.

3. European Alps.—As with the New Zealand Alps, the Californian Sierras, and the Canadian Rockies, so we should expect certain land-forms in the European Alps. The descriptions of Brigham (2), Davis (9a), Garwood (14), Penck (22) and others, have enriched our knowledge of this region. Each of such forms should be studied in connection with geologic structure, preglacial cañon-convergences, and cañon-broads or narrows. In studying glacial convergence one must not be altogether guided by the disposition of the lower cañon-base; he must consider the cañon as a whole, otherwise he will be led into serious errors.

For the European Alps, Garwood's excellent photographs reveal forms precisely similar to those expected by the writer on the assumption of the ice-flood hypothesis.

c. *Areas traversed by a Continental Ice-Sheet.*

Imagine an ice-sheet covering all or almost the whole of a large land-area. It is immaterial for our purpose whether the sheet forms at one or more centres. In the case of several centres the meeting-points are those, apparently, of reduced energy so far as external glacial work is concerned. The problem then resolves itself into one of a broad knowledge of preglacial topography.

i. Suppose the ice-sheet to descend an area of excessively rugged topography. The forms described under headings A and B should now be looked for. The less rugged the land-masses,

the less their vertical relief, and the wider the valleys the less marked the cañon-convergences (as concerns heavy ice-thrusting), and hence the less marked the resultant ice-thrusts.

Examples.—Possibly Patagonia and certain portions of Alaska. The Highlands of Scotland, and the English Lake District afford instructive examples of more moderate action.

ii. *The ice-sheet traversing areas of mature to senile topography.*

The ice-sheet now, as it covers the land-forms, has general directions of motion from its centres, but along those valleys only whose main axes coincide with these directions will the glacially-developed contours be similar and similarly situated. Each range and valley crossed by the ice-cap will now react on the passing mass, just as boulders and other obstacles in stream-channels react on the passing stream. And, here again, the writer would insist on the careful examination of the small, and easily understood stream-forms, so as to allow of correct reasoning thence to the majestic ice-flood contours. Local eddies are produced which, in each case, determine the contours at those spots. The general direction of the ice-motion will, of course, be unaltered, but local contours will be altogether inexplicable, unless one has a clear understanding of the action of water- or ice-eddies set up by the channel-obstructions.

Thus, imagine an ice-cap to be moving southwards from a land-mass, as shown at A in accompanying sketch, and crossing two valleys B and C, separated by a high ridge PP, and partly connected by a low *col* QQ. The valley B faces the east, and the valley CGCH the west. As the ice-cap moved over the high separating ridge the general motion of the mass was towards the south, but a lower ice-flow was set up easterly along the valley B. The *col* at QQ caused another local ice-eddy which, in turn, swept westerly down the upper portion of the valley CGCH. A cirque and basin may thus be formed at the foot of the *col* QQ, with alignment of valley-wall masses as in direction indicated by the arrows FF. All these forms are inexplicable on the assumption of ice-cutting from north to south only.

A very similar case was actually observed last January while visiting Mount Kosciusko in company with Professor T. W. E. David, who in (7), for the first time, had satisfactorily and clearly

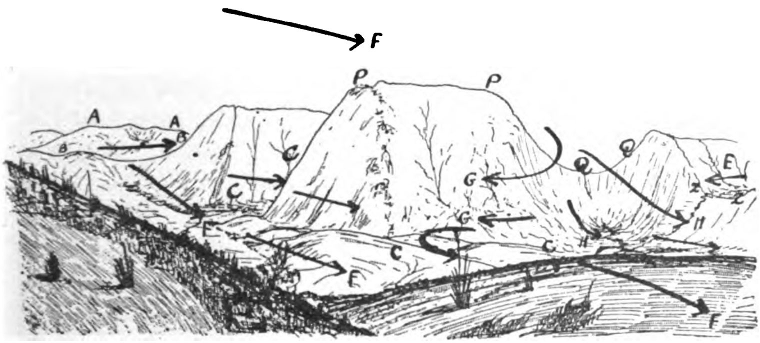

Fig. 12.—Ideal sketch illustrating action of ice-sheet at Kosciusko. AA, Kosciusko Range; BB, Snowy River Valley; CC, drainage of Spencer Creek; FFF, general direction of ice-motion; GG, HH, ice eddies-caused by col QQ and mountain PP; QQ, hanging valley caused by eddy HH. The arrows indicate the motion of the ice at various points, as suggested by the topography.

stated the existence of a magnificent Pleistocene glaciation for this area.

We insist again then, that first and last, the topography must not be lost sight of. Without the aid of figures it would be difficut to discuss the case in detail; several ideal examples may, however, be considered briefly.

(i.) *Cañons opening on to Flats or broad Valleys and facing the general direction of the Ice-Flow.*

The general land-surface would be but very slightly eroded, since there are few marked descents or convergences to increase velocity, and hence produce heavy local ice-thrusts. The basal ice, however, upon reaching the cañons would suffer convergence in being forced to flow up these narrow trenches while sealing the range. Hence added velocity with strong corrasion of these cañon bases.

Examples.—Finger Lakes of New York (?).

(ii.) *Wide valleys protected by fairly high but flaring sides.*

The general shape and arrangement of the valley will determine which side is specially selected for attack. Here again one must look for local ice-currents as in the analogous case of eddies in streams. One side of the valley will doubtless be protected while active cutting is in progress on the other side. As in the case of streams, one must not forget that although intense ice-action is probable, it can have but local application. And the wider the valleys, and the flatter the grades, all other things being equal, the more limited the intense action. This arises from the significance of the term base-level. Every water-pond is a potential waterfall, its capacity for work depending on the amount of head it may possess. Wide sluggish streams forced into narrows, or into any position where gravity has freer action, will accomplish wonders. The lower Amazon turned into the Yosemite cañon would accomplish such work as to amaze even experienced engineers. The tourist finds difficulty in recognising the smooth, and almost greasily-surfaced above-the-fall water as the same with that which pursues its mad career along the torrent-track under the falls. Yet the sluggish upper mass and and the lower "river gone mad, with boulders and mud for water," are one and the same. Niagara and Zambesi are the grand examples. It is but a simple application of the truth that, for streams, the power of transportation varies as the sixth power of the velocity. And here we perceive the reason for limited evidence only of intense former ice-cutting in areas of low relief. The points of intense action are those of great gravitative thrust, such as great fall or marked convergence. In fiord and alpine regions these conditions abound, hence magnificent contours; but as one rarely finds a Niagara on the low country, so one but rarely finds signs of magnificent rock-basining by ice over country of gentle relief.

Therefore the study of such glacial contours should properly commence in alpine regions, and thence be carried back among areas of less marked gravitative thrust.

(iii.) *Recession of great ice-flood, and subsequent smaller-flood action.*

The ground-moraines of the great ice-flood are too massive to be moved bodily by the shrunken glacier. The moraines are overriden simply and not used as weapons of corrasion; channels are excavated in these deposits; their surfaces are rounded and aggradation of pronounced surface-irregularities is characteristic. In this way the writer would account for many drumlin-mass surfaces. Doubtless the great drumlin-masses were due to the action of a great ice-flood; their present appearance is due to the mere rounding of same by smaller ice-flood visitation. Other conditions remaining unaltered, one must remember that the evidence of numerous small advances of an ice-sheet succeeding to a much greater glacial visitation admits of ready perception, whereas, on the flood hypothesis, the evidence of such weaker ice-mass visitations would be practically destroyed by a later severe glacial attack. Therefore, on the assumption of a period of stable equilibrium for a certain land-mass, one would expect only with great difficulty to trace the history of minor glaciation preceding a great ice-flood.

A knowledge of this simple fact may, again, explain many previous glacial difficulties.

B. *Ordinary Streams.*

All other geographic conditions being equal, land-areas dependent for their water-supply on terrific storms of infrequent occurrence should be reduced to base-level more quickly than one of much heavier precipitation, but not subject to violent storms.

Firstly, since the vegetation begotten of frequent rainfalls is a great check on corrasive activities.

Secondly, because the marked absence of great storms or "cloudbursts" in the moist region affords little opportunity for greatly increased work.

In the arid region the association of unprotected talus and "cloudbursts" is productive of marvellous corrasive results.

Example.—The graded condition of Western New South Wales streams as compared with the immaturity of streams in

the much moister eastern division of the State, the streams being of the same age.

C. *Shoreline Studies.*

The ordinary heavy gale is unable to use the weapons of the great storm of the century. Beneath the cliffs lie these great storm-relics, unaffected by the ordinary storm-wave; in fact they actually protect the cliff against the buffets of these lesser storm-waves. Thus, to the unobservant, the strength of the grand visitation is itself an evidence of flood-wave incompetency. Let, however, the requisite velocity be again forthcoming and the inertia of the flood-débris is once more overcome; the giant recommences work; the rock-shelf undergoes corrasion; and great sand-barriers are thrown up in spots removed from cutting curves. But with the departure of the great gale its working grade becomes too flat for smaller subsequent storm-currents to work along, and aggradation of these flood-contours ensues.

D. *The Peneplain.*

The peneplain is formed, approximately, at sea-level. However great the initial vertical relief, the streams make an early attempt to reach baselevel. In the cañon stage, many basins are formed actually below baselevel; with progressive reduction of land-surface—all other conditions remaining constant—the gravitative stream-thrusts become less. In extreme old age the streams have no action below baselevel, and the peneplain consists of a central system of very low undulating surfaces associated with wide plains showing a very gentle fall to main baselevel.

SUMMARY.

An examination of the flood-channel contours of ordinary streams reveals many interesting and significant features. Trenches with straight sides and terminating headward in basin-shaped contours are of common occurrence; the floors also of tributary streams are slightly hung above the base of the main stream, while the absence of spurs and alignment of banks or miniature bordering cliffs is pronounced. Basins also with

reversed grades downstream, but unassociated with troughs, are features of flood-channels.

Alike in the roadside gutter, the incipient cañon, the brooklet, the brook, the small and the mighty river, these forms occur over and over again. In each type of channel the dimensions of these peculiar contours are intimately related to those of the accompanying stream when in flood. Furthermore, such shapes, by direct observation, are known to express the work of the mightiest floods only which obtain in the various localities. And again the situations of such forms are exactly those which might have been easily predicted from considerations of gravitative thrust; that is, they occur :—

i. At points of marked convergence.

ii. Along lines working upstream from points of marked convergence.

iii. Along lines connecting points of marked convergence.

iv. Above points which, by reason of superior hardness or softness, have allowed of pronounced differential vertical corrasion.

These "facts of form" suggest that along a channel-floor of definite slope, a flood, or rather a flood-series, descended. The gravitative thrusts of the floods found partial, but not complete, expression in undermining of the channel-sides and in transportation of débris along the base. Relief, however, was in great measure afforded by vertical cutting; and this action ceased only when the vertical component of the gravitative thrust had been expended. A heavy flood-series expressed its maximum vertical thrusts as a succession of basins and troughs along the stream-channels, while subsequent lesser-flood action was incompetent to reduce the grades so formed, and was directed rather to aggradation of channel-base irregularities.

Again, forms almost identical with those just enumerated may be seen along shorelines or the cañons and valleys but recently vacated by the huge glaciers of the "Ice Age." The grandest contours of fiord cliffs and basins are not only similarly shaped but similarly situated to those formed by ordinary stream-floods.

The one marked difference is the wonderful disparity in size existing between water- and ice-formed contours.

Now in roadside gutters and other small stream-examples these peculiar contours are known, by direct observation, to originate in flood-water thrusts: in the cases of the great river-valley, the shoreline and the glacial cañon, we infer a similarity of origin for their similarly situated contours. And the reasoning is equally sound when applied to the case of the larger forms, for in addition to the similarity of contour-shape and location for both large and small examples; in addition also to the fact that floods occur in the cases of seawaves and ice, and that the peculiar shoreline and fiord contours under consideration do not rise above the highest floodmarks, the dimensions of the forms, in all instances, possess the most intimate relations with those of the heaviest floods. Thus the basins of roadside gutters rarely exceed a few feet in depth, while those of fiords and lakes in regions of former intense glaciation, besides being similarly situated to those of roadside gutters, may be thousands of feet in depth and many miles in length. Apparently, then the deduction is legitimate that all the forms have a similarity of origin, namely that of flood-stream action.

The apprehension of this truth is of the utmost significance. For since direct observations have shown that the striking irregularities of ordinary stream-developed channel-contours result from severe flood-action, and that lesser flood-action is confined, in the main, to working over the storm débris with aggradation of the larger channel-base irregularities, then a similar condition of affairs must also obtain along Amazonian or Mississippian channels, shorelines, and regions of former intense glaciation.

i. *Shorelines.*—Since, for waves of translation and for currents, power of transportation increases so amazingly with but moderate increase in velocity, the heavier material moved by the "great storm of the century" cannot be handled by succeeding gales of less velocity. Only with the visit of an equally strong wind can this heavy material be forced into activity, so that cliffs and rock-

platforms may be still further reduced. Until such time the weapons of the "record" gale, by their very mass, act as a decided protection to the shoreline, and energy is confined to rearrangement of smaller-storm débris and smoothing over of major irregularities of shoreline contour.

Similar reasoning applies to the action of the great storm in handling vast areas of sand, thus modifying the coastal profile. In this case it is the mass of sand capable of being moved in a given time which enables work thus to be done that is not wholly destroyed by successive years of interstorm activity.

ii. *Glaciation.*—The Glacial Period marked an ice-flood or a series of ice-floods, during which huge basins, spurless walls, terraced floors, hanging-valleys and cirques were formed. The disappearance of the Ice Age would signify a glacial drought. By analogy with ordinary stream-action, ice-stagnation would characterise such reduced glaciers. Along the old flood-worn channels the gravitative thrusts of these shrunken glaciers would be expended before the deeper portions (basins) of the channel bases were reached. These drought ice-streams then would be competent only to rearrange the old flood débris, and to round over the moraines. Hence arise:—

(a) Stagnating glaciers such as occur in the Muir and Melaspina localities.

(b) Pronounced overriding of moraines by glaciers.

(c) The peculiar appearance of drumlin areas.

(d) The obliteration of smaller ice-flood action by great ice-floods, on the assumption of stable equilibrium for the local land-mass during such glacial action.

Again, since maximum stream-thrusts are, from gravitative considerations, extremely localised and depend on channel-slopes and convergences, so glacial corrasion, as regards deep basin-formation and spur-cutting, is of rare occurrence. A Niagara, a Victoria, a Yosemite, or a Yellowstone waterfall is rare, and determined by some marked channel-grade discordance, whereby great velocity is attainable. So also the flood-glaciation of Yosemite, Alaska, Norway and other regions of similar great

topographical relief and "torrent tracks" would be marvellous; while in the more mature or even senile topography of the Central and Eastern United States, one would expect such heavy thrusts to be of extremely rare occurrence, and confined to gorges, to valleys facing the advancing ice-sheet, and to similar points at which convergence and, thereby, velocity is emphasised.

Especially important then is the necessity for understanding perfectly the state of dissection attained in preglacial time. Only in this manner may the work of the great local ice-eddies be appreciated.

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EXPLANATION OF PLATES XLIV-XLV.

Plate xliv.

The Junction of the Arthur and Cleddau Rivers, Milford Sound. Note the wonderful undercutting as shown on the cliffs to the right hand of picture.

Plate xlv.

Preservation Inlet. Glacial diffluences appear to be associated with weak glacial corrasion, as evidenced by islands. Contrast with Plate xliv., in which a marked cañon-convergence is shown.

DESCRIPTION D'UNE NOUVELLE ESPECE D'*OXYLÆMUS* (COLEOPTERA : *Colydiidæ*).

PAR A. GROUVELLE.

(*Communicated by Arthur M. Lea*).

OXYLÆMUS LEÆ, n.sp.

Elongatus, subcylindricus, nitidus, parce et sat longe pilosus, niger vel nigro-piceus, antennis, angulo apicali elytrorum pedibusque rufis; capite in medio laevi, ad latera dense profundeque punctato; clava antennarum in glandis speciem; prothorace subelongato, sat dense punctato, lateribus basique marginatis, hac arcuata, angulis anticis rotundatis, posticis obtusis; scutello minimo, punctiformi; elytris elongatis, ad apicem conjunctim rotundatis, punctatostriatis, intervallis striarum uni-lineato-punctatis, punctis remotis, stria suturali magis impressa, aliis ad apicem deletis, 2° intervallo ad apicem elevato, spatio inter suturam et carinam subconcavo. Long. 4·5 mill.

Allongi, subcylindrique, brillant, couvert d'une pubescence formie principalement de poils longs, dressés, rares sur le disque du prothorax et des elytres, plus dense sur les côtés et de poils egalement longs et rares, mais conchés inseres surtout sur la tête et le devant du prothorax; tête et prothorax noirs, elytres brun de poix à reflets très, légèrement bronzé, un peu rougeâtre à la base, dans la region scutellaire et au sommet; antennes et pattes rougeâtres. Antennes terminies par un article en forme de gland, composé très probablement d'un premier article lisse, emboitant la base d'un article oblong, pubescent. Tête lisse sur le milieu, densement et fortement

ponctué sur les côtés, bouche rougeâtre. Prothorax à peine d'un quart plus long que large, assez densement et fortement ponctué; bords latéraux et base finement rebordés; sommet subtronque à peine sinni dans le milieu, base arquée; angles anterieurs arrondis, posterieurs obtus. Ecusson petit, suborbiculaire. Elytres environ quatre fois plus longs que larges ensemble, arrondis ensemble au sommet, ponctués-striés; strie suturale entière, bien mangerie, les autres effacées au sommet; intervalles à peine vieillement ruguleux, chacun avec une ligne de points espacés; 2^{me} intervalle sans compter l'intervalle sutural élevé vers le sommet, espace compris entre cette pseudo-carine et la suture légèrement concave. Metasternum sans sillon longitudinal, finement strié; 1er segment de l'abdomen ponctué sur toute la surface.

Hab.—Tasmanie: Mont Wellington, Frankford, Hobart, Zeehan.

Cette espèce m'a été obligeamment communiqué par Mr. Lea qui on'a autorisé a la décrire.

WEDNESDAY, NOVEMBER 27TH 1907.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, November 25th, 1907.

Mr. J. H. Maiden, F.L.S., Vice-President, in the Chair.

Mr. W. BASSETT HULL, Department of Mines, Sydney, was elected an Ordinary Member of the Society.

The Chairman reminded Candidates for Fellowships that 30th inst. was the last day for sending in applications.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 4 Vols., 44 Parts or Nos., 4 Bulletins, 1 Report, and 4 Pamphlets, received from 41 Societies, &c., and one Individual, were laid upon the table.

NOTES AND EXHIBITS.

Dr. Chapman communicated a note on the results obtained by him, in collaboration with Professor Welsh, with regard to the weight of precipitum yielded by antisera when interacting with homologous protein. An ostrich egg-white antiserum produced 76 mgs., or 3·8 mg. for each c.c. antiserum. Two horse-serum antisera deposited 45·7 mg., or 1·4 mg. from each c.c. antiserum. Three hen egg-white antisera gave 142·9 mg., or 2·7 mg. for each c.c. antiserum. The antisera were precipitated with full weights of homologous proteid dissolved in normal saline solution. The salt solution diluted the antiserum about 4 times. The deposits were collected after 48 hours, washed with salt solution, distilled water, alcohol, and ether, and then dried and weighed. This appeared to be an accurate method of estimating the precipitable content of an antiserum.

Dr. Chapman also showed a microscopic slide which illustrated the phagocytosis of tubercle bacilli by washed leucocytes. The bacilli and leucocytes were in contact in normal salt solution at 37° C. for two hours. Rather more than 25 % of the polynuclear leucocytes contained numerous bacilli, the remaining polynuclear leucocytes being free from bacilli.

Mr. Fred. Turner exhibited, and offered observations on, some very interesting flowering specimens gathered from a tree thought to be a natural hybrid between *Sterculia diversifolia* G. Don, the "Kurrajong," and *S. acerifolia* A. Cunn., the "Flame Tree." The leaves are ovate-lanceolate, shortly acuminate, quite glabrous and correspond, even to the venation, to the simple-leaved form of the former species. The inflorescence, which is disposed in axillary panicles much exceeding the foliage, is quite glabrous except for a slight tomentum on the margins of the calyx-lobes, of a bright red colour on the outside resembling the calyces of *S. acerifolia*, but inside marked with yellow and purple like those of *S. diversifolia*. Male flowers only seen.

Mr. T. Steel exhibited a very large specimen of Saunders' Case-Moth (*Metura elongata* Saund.), the case being 7 inches in length and the moth itself 4½ inches.

Mr. D. G. Stead exhibited a curiously deformed right claw of a large Mangrove Crab, *Scylla serrata* (Forskal), which showed a remarkable "attempt" at the formation of a supplementary "nipper" on its lower surface.

Mr. R. T. Baker exhibited a specimen, together with a coloured drawing, of a representative of the rare genus *Adenochilus* [N.O. ORCHIDEÆ] obtained at Wentworth Falls, Blue Mountains, on the 11th inst. by Mr. F. H. Taylor. Only a single species of the genus, *A. Nortoni* Fitzg., had been recorded for Australia, and that from Mount Victoria. The plant exhibited differed in some respects from Fitzgerald's description and figure; it was smaller, more delicate, with pink flowers and a much smaller basal leaf. The flower was also less than half the size,

and had two sepals and two petals instead of three of the former organs, as figured by Fitzgerald. In some respects it resembled *A. gracilis* of New Zealand, but the winged column differentiated it from that species.

Mr. Kesteven exhibited preparations of the eyes of a tadpole of a species of Hyla, from the Histological Laboratory of Sydney University. The elements of the retina, more especially the rods and cones, were more easily studied in such preparations than in those of mammalian eyes in general.

Mr. Jensen showed series of rock-specimens, and lantern views, illustrative of the geology and topography of the Nandewar Mountains.

Mr. E. Cheel exhibited an interesting collection of rare or noteworthy Fungi, from New South Wales, comprising the following eighteen species.

PHALLOIDEACEÆ.

Clathrus cibarius Fischer (Lace-Fungus)—Mywye, Yarrangobilly (A. G. Watts; May, 1900); Botanic Gardens, Sydney (A. Grant; May, 1900); Centennial Park (W. Forsyth); Botany (Mr. Abrahams; September, 1901); Arncliffe (W. Gaymer; June, 1907); Gladesville (Miss M. Flockton; June, 1907). Previously only recorded for New South Wales by C. T. Musson in Hawkesbury Agric. Coll. Journ. ii. p.26 (1905).

C. cibiarius var. *gracilis* (Berk.)—Artamon, North Sydney (A. Cretin; August, 1907).

C. pusillus Berk.—Swanbrook, Inverell (on sandy soil; Geo. Munsie; June, 1907). Previously recorded from West Australia, Queensland, and from Wide Bay (These Proceedings, 1880, v. p.78).

POLYPORACEÆ.

Fomes applanatus Wallr. (?).—Botanic Gardens, Sydney (on trunk of *Acacia horrida* Willd.; E. Cheel; July, 1907). Previously only recorded from Victoria and Queensland. The

mycelium had eaten through the trunk of this tree and caused its death. The sporophore measures 13 × 8½ inches.

LYCOPERDACEÆ.

Catastoma anomalum (Cooke & Mass.) Lloyd—Penshurst, Hurstville, and Bankstown (on the ground, very common; E. Cheel; March, 1907). C. G. Lloyd records this from "Rockwood (? Rookwood) Australia" collected by R. T. Baker.

Lycoperdon polymorphum Vitt.—Botanic Gardens, Sydney (on lawns; E. Cheel; June,.1907).

L. pusillum Fr.—Penshurst and Bowral (on the ground; E. Cheel; June and August, 1907).

Tulostoma mammosum Fr.—Penshurst (on grassy land; E. Cheel; June, 1907).

Scleroderma flavidum Ellis.—Botanic Gardens, Sydney (on the ground; E. Cheel; July, 1907). There are specimens in the National Herbarium from Jenolan Caves and Mount Victoria, collected by Mr. J. H. Maiden.

Polysaccum pisocarpium Fries.—Governor's Domain, Sydney (on the ground under pine trees; E. Cheel; May, 1907). Previously recorded from Coogee (These Proceedings, 1906, p.720).

XYLOMACEÆ.

Ectostroma liriodendri Fr.—Botanic Gardens, Sydney (on Tuliptree leaves [*Liriodendron tulipifera* Linn.]; E. Cheel; Dec., 1906, and Nov., 1907). Not previously recorded for Australia.

SPHÆRIOIDEÆ.

Actinonema rosæ Lib.—Botanic Gardens, Sydney (on "Liberty" rose leaves; E. Cheel; January, 1907). Previously only recorded for Victoria and Queensland.

USTILAGINEÆ.

**Ustilago muelleriana* Thum.—Centennial Park (on young fruits of *Juncus planifolius*; E. Cheel; Sept., 1900).

**Cintractia cynodontis* (Henn) McAlp. in lit.—Botanic Gardens, Sydney, and Penshurst (on the inflorescences of Couch or Dub-grass [*Cynodon dactylon*]; E. Cheel; Jan., 1907). New for Australia.

PUCCINIACEÆ.

Puccinia pruni Pers.—Penshurst (on peach, plum, and apricot leaves, and also on peach fruits; E. Cheel; April, 1907). Previously recorded for New South Wales by McAlpine ("Rusts of Australia," p.171, 1906).

P. dichondræ Mont.—Penshurst (E. Cheel; 1907). Previously recorded from Richmond and New South Wales in McAlpine's "Rusts of Australia," p.142 (1906).

P. poarum Niels.—Penshurst (on *Poa annua*; E. Cheel; June, 1901, and Aug, 1907).

**P. saccardoi* Ludw.—Cataract River Road (on leaves and calyces of *Goodenia hederacea*; E. Cheel; March, 1907). Previously recorded from Guntawang, on *Velleia macrocalyx* De Vriese, and *V. paradoxa* R.Br., *vide* McAlpine's "Rusts of Australia," p.148 (1906).

MYXOMYCETEÆ.

Diachaea leucopoda Rost.—Botanic Gardens, Sydney (on Euca lyptus leaves and on trunks of willow trees; E. Cheel; June,1907).

For the determination of the species whose names are marked with an asterisk the exhibitor was indebted to Mr. D. McAlpine, of Melbourne.

THE GEOLOGY OF THE NANDEWAR MOUNTAINS.

By H. I. Jensen, B.Sc., Linnean Macleay Fellow of the Society in Geology.

(Plates xlvi.-lii.)

A. General Geology and Physiography.

1. Introduction.

The mountains described under this name lie in the Counties of Nandewar, Murchison, Jamieson and Darling, and are situated between the townships of Narrabri, Barraba and Bingera. In a former paper I made brief mention of this group of mountains (These Proceedings, 1906, p.235); since its publication I have spent two more months in the district, and am in consequence able to give a more detailed account.

The Nandewar Mountains in their physiographic features bear close resemblance to the Warrumbungles, and they are exceedingly rich in rock-types.

The region is, from a geological standpoint, practically unexplored, though parts have been visited by Mr. E. F. Pittman, A.R.S.M., Government Geologist; and by Professor T. W. E. David, B.A., F.R.S. His Honor Judge Docker has visited practically all parts of this region to take scenic photographs, and is probably better acquainted with it than anyone who has made casual trips to it.

2. Petrography.

The rocks of the Nandewar Mountains may be conveniently divided into Sedimentary, Metamorphic, and Igneous.

The *Sedimentary Rocks* include (a) Carboniferous conglomerates and grits, chiefly in the S.E. and E. portions of the area; (b) Permo-Carboniferous conglomerates, grits, sandstones and shales, forming the country rock in the area where volcanic activity has been greatest. The Permo-Carboniferous rocks continue westward under the plains, and are also the most important formation in the Rocky Creek district. (c) Trias-Jura rocks, forming mesas capping the Permo-Carboniferous. (d) Tertiary deposits.

The *Metamorphic Series* includes (a) slates, cherts and schists of Devonian age associated with the Carboniferous rocks in the S.E. (at Coolah Station). (b) The limestones and serpentines in the Horton River basin, east of the Nandewar Mountains, outside the district which I have myself examined.

The *Igneous Rocks* comprise (a) granite, as rolled boulders in Maule's Creek.

(b) Akerite, occurring as laccolitic bosses and sills at the head of Bullawa Creek. Also ægirine-nepheline syenite, forming sills in the same region.

(c) Sills of syenite-porphyry and bostonite.

(d) Trachyte, phonolite and rhyolite, with all kinds of texture, from aphanitic and even-grained to coarse and porphyritic, and from compact to highly vesicular. These rocks occur as lava-flows or eappings, dykes and sills throughout the area extending from Deriah Mountain on the

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south to Couradda (Grattai) Mountain on the north, and from Noogera Creek on the east to the 1,000-feet contour on the west.

(e) Tuffs allied to the lavas in (d).

(f) Felspar porphyrites with labradorite phenocrysts exceeding in some case two inches in length and ¾-in. in thickness. This porphyrite occurs in sills associated with ægirine syenite sills which contain inclusions of fine-grained nepheline phonolite (*vide* Petrological Notes, N.12, N.11, and N.10).

(g) Porphyritic basalt with labradorite phenocrysts exceeding two inches in length.

(h) Lamprophyric porphyrite occurring as a sill at Dingo Creek. This rock has huge phenocrysts of rhombic pyroxene, some of which are from three to four inches long.

(i) Basalts capping the other lavas. Some of the basalts contain no olivine and resemble closely that from the Sandilands Ranges. The last erupted contain olivine.

(j) Tertiary (?) rhyolites and rhyolitic tuffs to the S.W. of the Nandewars between Maule's Creek and Boggabri. These rocks form cones and necks, and exist also to the west of Boggabri.

(k) Quartz porphyries and old rhyolites associated with tuffs and breccias at the head of Oakey Creek, Coolah, and between Maule's Creek and Barraba. These rocks appear to be of Carboniferous age.

Alluvials and Windblown Deposits.—(a) Black Soil Plains, as at Narrabri, occurring far and wide with interspersed sandy patches on the plains. The black soils are usually of river deposition, and are often of great depth. The alluvials and Tertiary deposits at Narrabri attain a thickness of over 1,000 feet.

(b) Poor sandy pine scrubs of the Pillaga type. The edge of Pillaga scrub is encountered on the Narrabri-Boggabri Road about 11-12 miles south of Narrabri (near Turrawan).

3. Geomorphology (including Physiography, Topography and Descriptive Geology).

To illustrate this part I have prepared two sketch maps, one of the Nandewar Mountains and Nandewar Range, including

outlying parts which I have not visited (Plate xlvi.); and the other a map of the Nandewar Mountains themselves which I have personally investigated (Plate xlvii.).

The former is intended to bring out the following features :—

(a) The distinction between what is known as the Nandewar Range and the Nandewar Mountains proper. The Nandewar Range is an offshoot of the Moonbi Ranges, and connects the New England Mountains with the Nandewar Mountains proper. It forms a watershed between the Horton and Manilla Rivers. The Geological Survey Department's Map of New South Wales (compiled under the direction of Mr. Pittman, Government Geologist, 1893) shows that this range consists of Permo-Carboniferous rocks and older rocks of Carboniferous and Devonian age, such as serpentine, limestone, slate, &c., but where it merges into the Nandewar Mountains proper (which might appropriately be termed the Lindesay Group) these old rocks are capped with the lavas of the Tertiary trachyte and basalt series.

(b) The direction of flow of the rivers and creeks.

(c) The mountainous nature of the country between the Nandewar Mountains and New England.

(d) The geological formations of the country from which, in conjunction with the configuration, deductions may be drawn as to its geological history.

The second map shows the configuration and the geological formations of the Lindesay Group, from which deductions will be drawn in the section on Geomorphogeny.

The Nandewar Mountains as seen from afar (as from Narrabri or from the Warrumbungle Mountains peaks) form a dome-shaped mass. The highest point of the group is Mount Kaputar, about 5,000 feet high, and the Lindesay Tableland surrounding it is over 4,000 feet in average altitude, with many eminences on it approaching 5,000 feet. The Nandewar Mountains (Lindesay group) cover an elongated oval area, having its long axis running N.N.W.-S.S.E. The highest peaks are situated on this axis, from which spurs capped with smaller peaks run W.S.W. and E.N.E. The spurs are separated by deep, narrow, gorge-like

valleys, with steep, often precipitous, walls on each side. The cliffs usually expose sandstone up to a certain height (about 2,000 feet), above which we find flows of trachyte. Both in a N.N.W. and in a S.S.E. direction from Mount Kaputar the axis gradually declines in altitude; so that, at the head of Bobbiwaa Creek it averages only about 2,500 feet; and at the head of Oakey Creek (Coolah Station), a branch of Maule's Creek, its height is 2,400 feet, though peaks of higher altitude are met with on the chain.

The Black Soil Plains surrounding the Nandewar Mountains resemble those already described for the Warrumbungles. They may be either with or without forest. The commonest trees on the forested black soil plains are box (*E. hemiphloia* var. *albens*, and *E. Woollsiana*), apple trees (*Angophora intermedia*), ironbark (*Eucalyptus crebra*), oaks (*Casuarina Cunninghamii* and *C. Cambagei*) along watercourses or plains of alluvial origin; and box (*E. hemiphloia* var. *albens*), with myall (*Acacia pendula*), ironbark (*E. melanophloia*), wattles (*Acac a*), when black soil is purely of volcanic origin as at Bobbiwaa Creek.

The Pilliga Scrub adjoining Narrabri at Turrawan answers to the description already given of other parts of the same area. It consists of a thick pine (*Callitris calcarata*) jungle with occasional ironbarks (*Eucalyptus sideroxylon*) and wattles interspersed, growing on deep white or yellow sand. The lower branches of the pines exhibit a remarkably even skyline, due to a process of natural pruning which is better illustrated here than at any other spot which I have seen in Australia. Patches of poor sandy country of the Pilliga type occur also between Maule's Creek and Boggabri. Here it is very undulating, capped with table-topped hills (mesas) of conglomerate and sandstone which are probably of Trias-Jura age. These mesas would, if their tops were continuous, form an inclined plane sloping away from the Nandewar Mountains. In this way, too, the mountains descend into the plain in a southerly direction. In the Parish of Namoi, County Darling, they run into the Namoi River and disappear. Around Boggabri and west of this township the country would be

level but for the numerous volcanic knobs of rhyolite and rhyolitic tuff and breccia which are bestrewn over the plain, and rise above it to a height of 500 feet or more. These rhyolites probably are Tertiary eruptives, but may be older. At all events they intrude the sandstone (Permo-Carboniferous ?).

West of the Nandewars, around Narrabri, thence westwards in the direction of Walgett and northwards towards Moree, the country is almost perfectly flat, consisting of black soil plains and interspersed sandy patches of the Pilliga type. There are jutting out of the plains a few miles east of Narrabri several small hills composed of porphyritic basalt and basic tuff. To the north-west of the Nandewars, in the Parishes of Mellburra and Myall Hollow, there are a few hills, almost conical in shape, such as The Haystack and The Little Haystack. They, too, are basaltic. In the Counties of Murchison and Darling, east of the Nandewar group, the spurs of the latter are also, according to the Geological Survey Map, capped with basalt; and basaltic intrusions, and extrusions occur at intervals throughout the area lying between the Nandewar Mountains and New England. My own observations, as far as they go, show that volcanic rocks (trachytes and basalts) cap the ridges east of the Nandewar group.

Dykes of basalt have been noticed cutting the trachytic and phonolitic rocks in the Nandewar Mountains. This shows that here, as in the case of the Warrumbungles, the last eruptions were basic and extended over a wide area.

Bullawa Creek, from the petrologist's point of view, is by far the most interesting locality in the Nandewars (Fig. 1). On the south side of the creek near Ritter's homestead numerous broken hills intervene between the lava-tableland (Ningadhun, Coryah, etc.) and the creek. In these, sandstone is usually the dominant formation to a height of about 2,250 feet, and a slight S.E. dip is generally observed. It seldom exceeds 5°. A bed of coarse conglomerate with abundant quartz and cherty pebbles is met with at an altitude of 1,900 feet. To the north of the creek no broken hills intervene; an abrupt razorback range forms the

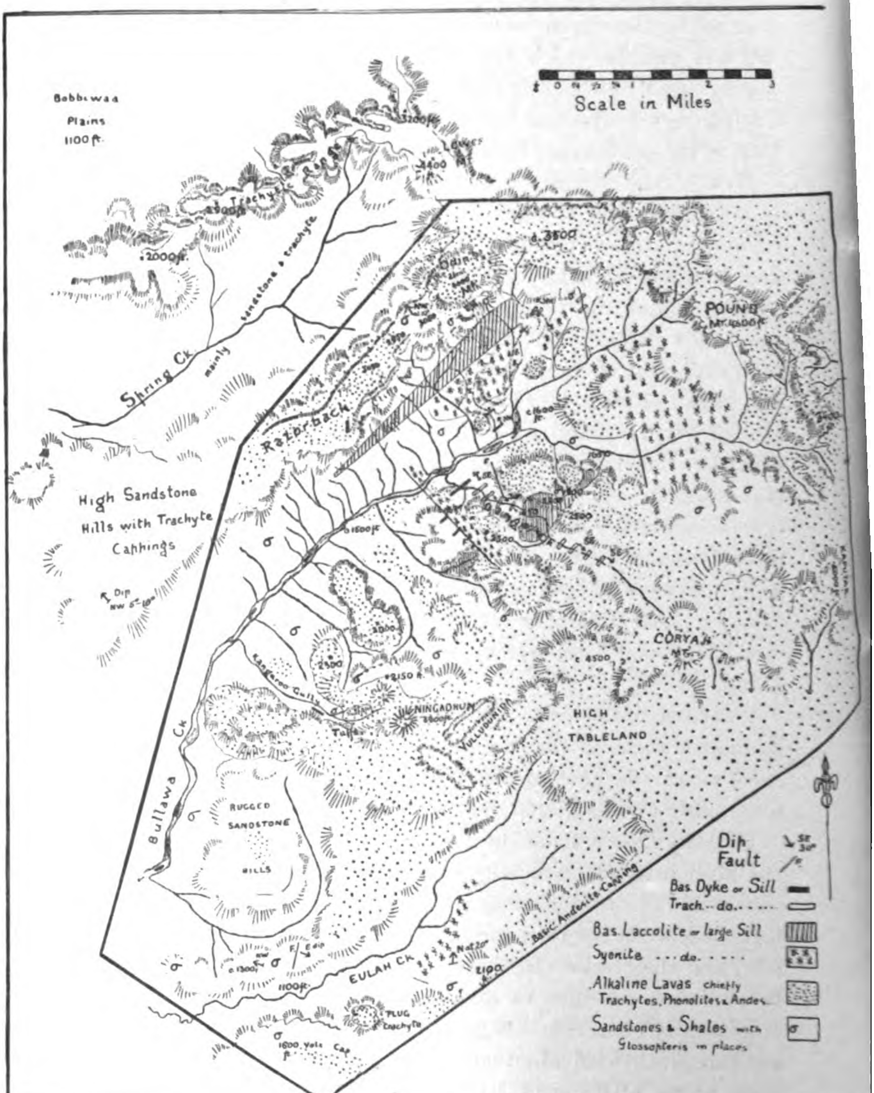

Fig. 1.—Geological Sketch Map of Bullawa Creek.

watershed between Bullawa Creek and Spring Creek. In this razorback the coarse conglomerate bed is met with at an altitude of 2,000-2,100 feet, about 200 feet higher than one mile south. This means a dip of 1 in 25 to the south, or of about 5° to the S.E.

Kangaroo Gully is interesting because of the occurrence there of a type of porphyritic basalt with phenocrysts of plagioclase up to two inches in length. The basalt penetrates sandstone and apparently also trachytic tuffs. It is similar to basalts found elsewhere in the Nandewars intruding and capping the trachytes, being alkaline and without olivine. Both in hand-specimen and under the microscope the Nandewar post-trachytic basalts resemble the Sandilands Ranges basalt. On the east side of Kangaroo Gully there is a high trachyte ridge commencing in the Sugarloaf, N.N.W. of Ningadhun. The trachyte of the ridge caps trachytic tuffs, which again overlie sandstone. The trachyte is therefore a flow which has infilled an old valley. On the western side of the gully the formation consists of tuffs and breccias. In the Triassic (?) sandstones north of Kangaroo Gully there are carbonaceous shales but no fossils. The dips are somewhat disturbed.

East of Kangaroo Gully occurs a sill-like or laccolitic mass of arfvedsonite trachyte porphyritic in anorthoclase. To the north this merges into an eruptive conical mass.

The ascent of Ningadhun from the N.N.W. is interesting, inasmuch as various kinds of alkaline volcanic rock are met with in well defined sheets as shown in Fig. 2. Ningadhun rock itself is a plug left by the removal of surrounding tuffs. Behind Ningadhun on Yullundunida there is a slanting dyke-like razorback dipping sharply to the S.E. It appears to be a relic of a surface-flow from Ningadhun capping the tuffs now removed by denudation (Plate 4). About half-a-mile N.N.W. of Ningadhun there is a sugarloaf of arfvedsonite trachyte which represents a plug in a parasitic vent.

The sandstone beds north of Bullawa Creek have a slight N.W. dip. The S.E. dip so general on the other side of the

creek is probably induced by a subsidence along a fault running E.N.E.-W.S.W. from Kaputar in the direction of Ningadhun, the plugs of Kaputar, Corrunbralborawah, Coryah, Ningadhun being situated on this line. The range north of Bullawa Creek,

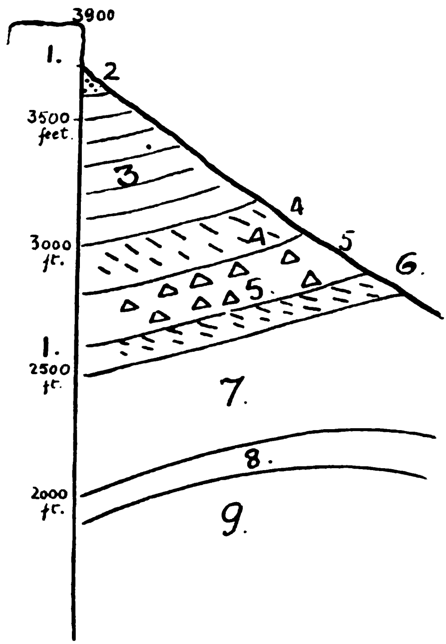

Fig.2.—Structure of Ningadhun Rock.
1, Silky Arfvedsonite trachyte; 2, Black trach. glass; 3, Coarsely porph. hypohyaline black trach.; 4 and 6, Red neph. phonolite; 5, Trach. breccia; 7, Common varieties of alk. trach.; 8, Tuffs; 9, Conglomerates and sandstones.

Ritter's Razorback, has trachytic rocks (tuffs, breccias and lavas) above a height of 2,200 feet. In places these rocks become andesitic, in others phonolitic. They frequently exhibit spheroidal weathering and onion-structure.

From the structure observed in the country on both sides of Bullawa Creek at Ritter's as described above (Figs.3, 4, 5) it

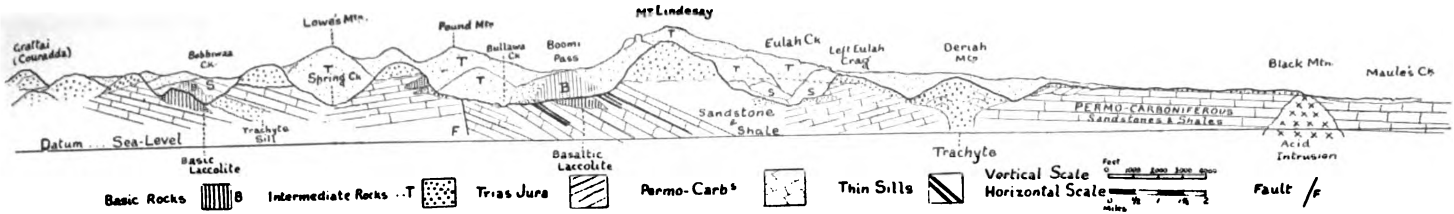

Fig. 3.—Section in a general N. and S. direction through the Nandewar Mountains.

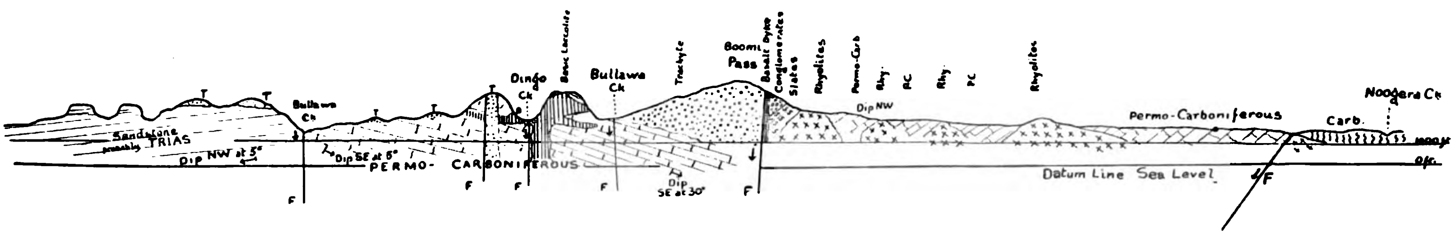

Fig. 4. Section in a general E. and W. direction through the Nandewar Mountains.

appears that the trachyte has flowed over an eroded surface and infilled the valleys. The present valleys, such as that of Bullawa Creek, represent the high ground before the period of the eruptions; the thin flows capping the sandstones here having soon become denuded away, erosion has rapidly carved out valleys in the softer sandstones and shales.

North by east to north-north-east from Ritter's farm The Razorback attains a height of 3,050 feet and is capped with vesicular amygdaloidal trachytes. Further eastward, about $\frac{3}{4}$ or $\frac{1}{2}$ a mile from Mount Odin, sandstones and conglomerates dipping N.W. at 5-10° cap the range at an altitude of from 2,950 to 3,050 feet (Fig.5). The change in formation makes an immediate change in the forest flora, pine (*Callitris calcarata* ?) and

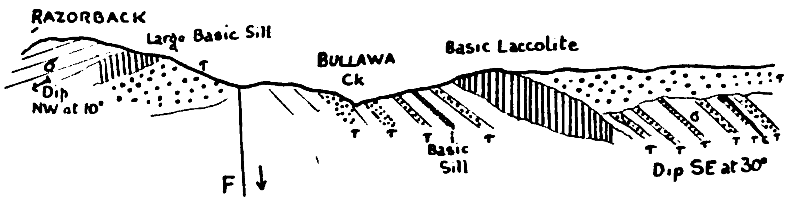

Fig.5.—Section across Bullawa Creek at Dawson's, in a general N. and S. direction. F, fault; τ, trachyte or bostonite; σ, sandstone.

oaks (*Casuarina Luehmanni* and *Cambagei*) replacing the box and gum. Smaller cappings (relics) of trachyte occur here too. On descending The Razorback, walking southwards towards the junction of Bullawa and Oakey Creeks, a large sill or dyke of basic rock is met with. The outcrop is 300 yards wide. Below this basic mass trachyte porphyry becomes the country rock, and represents a laccolitic offshoot of the Mt. Odin mass (Fig.5). Mt. Odin is precipitous on the northern, western, and southern flanks, and has a steep slope to the east towards the gap between Bullawa and Pound Creeks. The cliffs consist of sandstone beds alternating with trachyte or porphyry sills. My brother in proceeding up the creek called on my map Thor's Gully, observed numerous sills of trachyte and dolerite intruding sandstones,

carbonaceous shales and conglomerates. The sills frequently locate waterfalls in the creeks.

The country between Mount Odin, Rocky Creek Gap, and Oakey Creek is very broken, consisting of dark green porphyry sills and trachyte porphyry sills intruding Permo-Carboniferous sandstones and shales with Glossopteris. Nearly all the hills have cappings of vesicular trachyte.

Further up Oakey Creek, about a mile above its junction with Bullawa Creek, massive syenite (akerite) is met with on both sides. This rock has a pepper-and-salt colour, and would make a beautiful building stone.

Some of the dark syenite-porphyry sills contain angular and rounded included masses of nepheline phonolite, which seem to be fragments of the already cooled magma torn off the walls of the lava-reservoir in the upward passage.

Oakey Creek contains pebbles of dark syenite-porphyry, grey (pepper-and-salt) syenite, red syenite, essexite, ægirine trachyte, ægirine phonolite, red trachyte, trachyte porphyries, basalt and basalt porphyrites; therefore all these rocks must occur in the area which it drains. Grey syenite (akerite) covers a large area of rugged country between Oakey Creek and Upper Bullawa Creek. The occurrence of pine higher up the range under Pound Mountain shows that the syenitic mass has a sandstone capping. Above the sandstone on Pound Mountain and the Nandewar Range in general there is a capping of vesicular volcanic rocks.

The upper part of the Bullawa Creek (that is above its junction with Oakey Creek) cuts through great igneous masses of trachyte and trachyte porphyry. Very little sandstone is seen in the area. Here and there a small remnant may be noticed high up on the mountain sides, and may be taken to represent either a floated-up portion of the country rock or remnant of a sill-capping which has not been resorbed.

South of Bullawa Creek we have a great tableland capped with the peaks Kaputar, Corrunbralborawah, Coryah and Ningadhun. This mass consists at the base of Permo-Carboniferous sedimentary rocks intruded by numerous sills and laccolites with a

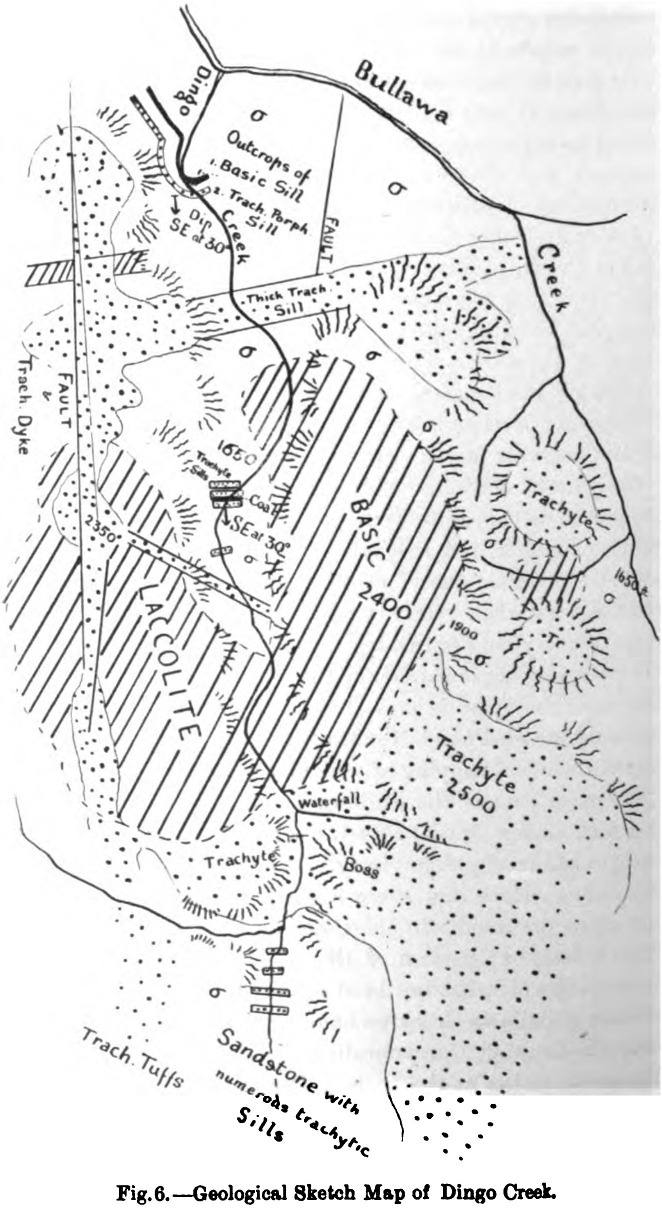

Fig. 6.—Geological Sketch Map of Dingo Creek.

covering of vesicular volcanic rocks. Bullawa Creek itself flows from its junction with Oakey Creek through sandstone and trachyte sills. Sandstone, shale, dolerite, trachyte, and many other rocks chiefly related to the trachyte family occur in the broken country between it and the tableland.

At Dingo Creek most interesting features were observed. Not far (about 250 yards) from its junction with Bullawa Creek there is a remarkable sill of lamprophyric porphyry intruded along a coal seam (S_1). The dip of the strata is S.E. at 25°. Below and above the sill there are Glossopteris and Noeggerathiopsis shales and cherts indurated by the intrusion.

About 500 yards further up the creek we meet with the boundary of a great laccolite of basic porphyrite intruded by occasional trachyte dykes. As I have seen sandstone both overlying and underlying this rock, I have no doubt it is a laccolite. Sandstone dips are somewhat disturbed near its edges. Further up the creek the basic rock is seen sometimes only on the east bank, sometimes on both banks, and the creek has largely carved its way along the western edge of the mass. On the west bank of the creek, cliffs of sandstone with coal seams and Glossopteris shales are common. They dip S.E. at 25-30° and contain interlaminated sills of trachyte porphyry and bostonite, which generally have penetrated along a coal seam. The hills west of Dingo Creek are capped with trachyte, but those on the east side for some distance consist chiefly of dolerite, with trachyte cappings overlying it in places, a fact which proves that denudation had removed the sandstone covering of the basic laccolite before the trachytic rocks were poured out. The dolerite is of various degrees of crystallinity, some very coarse-grained, some, especially near the edges of the mass, fine-grained.

The ridge between Dingo Creek and the creek west of it owes its existence to a broad trachyte dyke running S.E.-N.W., from which many sills and dykes at right angles to it and flows capping the hills are derived. The basic laccolite has a maximum thickness of about 700 feet (Fig.4).

On proceeding higher up the creek, sandstones, shales and interlaminated sills repeat themselves, and the hills on both sides have lava-cappings.

Boomi Creek.—From Bullawa Creek I made an excursion across the mountains to Boomi Creek. The crest of Boomi Gap has an altitude of about 3,500 feet. South of it lies Kaputar (5,000 feet), north of it Pound Mountain (4,500 feet). In ascending the pass from the west one encounters practically only trachyte. However, on descending to Boomi Creek one crosses a basaltic dyke, running N. and S., at a height of 3,000 feet; at 2,900 feet there is an outcrop of greenish slaty rock; at 2,800 feet an outcrop of coarse conglomerates dipping north. These rocks are probably Permo-Carboniferous, perhaps Carboniferous. Lower down rhyolitic and andesitic tuffs and quartz porphyries are met with as well as conglomerates with rhyolite pebbles. These volcanic rocks and conglomerates are lithologically the same as those occurring at Laird's on Maule's Creek, Horse-Arm Creek and Black Mountain south of the group. Below the 3,000-feet level the Boomi Creek country loses the wild ruggedness characteristic of the Bullawa Creek side, consisting of more gently-sloping, wooded and grassy spurs well adapted for grazing. The change in scenery is due to the change in formation, Lower Permo-Carboniferous or Carboniferous rocks being here predominant, and the barren trachytes, Upper Coal Measure and Triassic sandstones being seldom seen. In Boomi Creek there are numerous boulders of coarsely porphyritic basalt with gigantic felspar phenocrysts similar to that which caps the intermediate rocks round Deriah and intrudes them in Kangaroo Gully. This rock is probably derived from Kaputar.

Eulah Creek.—This creek rises in the Lindesay Tableland and flows parallel to Bullawa Creek into the Namoi. The country in which its two branches head is like that at the head of Bullawa Creek, consisting of sills of intermediate rock intruding Permo-Carboniferous or Trias-Jura sandstones, which rise abruptly on either side to form a tableland capped with lava. The creek, like Bullawa Creek, flows in a gorge-like valley, which at

Dunmore's place, where I camped (altitude 1,150 feet), has sandstone cliffs 400 feet high on either side. Higher up the creek cliffs of igneous rock are frequently seen. Ascending the tableland south of Dunmore's the sandstone formation was seen to persist to a height of 1,600 feet, where dark, fine-grained cappings of ægirine-trachyte or andesite commenced. Much of it is quite scoriaceous. The sandstone north of the creek has a gentle dip to the N.W. at Dunmore's, changing to N.E. as one proceeds upstream. South of the creek it has a gentle westerly dip.

Between Dunmore's and Deriah Mountain coarsely porphyritic basalts without olivine and andesites cap the trachyte in various places on the tableland at a height of 1,650-1,700 feet. The forest vegetation improves at this level, consisting of box (*Eucalyptus albens*), cedar (—— ?), kurrajong (*Sterculia diversifolia*), watergum (*E. rostrata*), and wattles. A basaltic crater occurs a couple of miles west of Deriah. Boxtree Gully heads near it (Fig.8).

Deriah Creek heads near Deriah Mountain, the structure of which is represented in Fig.7.

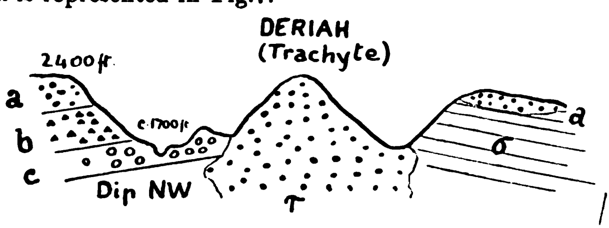

Fig.7.—Section, in a general E. and W. direction, at Deriah. a, andesitic rock; b, trachyte breccia; c, vesicular trachy-andesite; τ, arfvedsonite trachyte; σ, sandstone (Triassic ?).

The Deriah Mountain trachyte is *older* than the fine-grained blue ægirine-nepheline phonolite and phonolitic trachyte which occur under the basalt of the surrounding hills (Figs.7 and 8).

At Left Eulah Crag on Eulah Creek, north of Deriah, a large sill of even-grained arfvedsonite-trachyte intrudes the sandstone and forms a bold cliff. In the area lying between Deriah and Eulah

Crags the hills are commonly capped with a coarse andesitic or trachytic breccia.

It is probable that on the tableland between Eulah and Bullawa Creeks, basalt caps the alkaline intermediate rocks. The curious, long dykes surmounting the plateau are evidence of fissure-eruptions which first gave rise to tuffs, and later on to lavas, the flows of which have been undermined by the subsequent weathering away of the underlying tuff-beds.

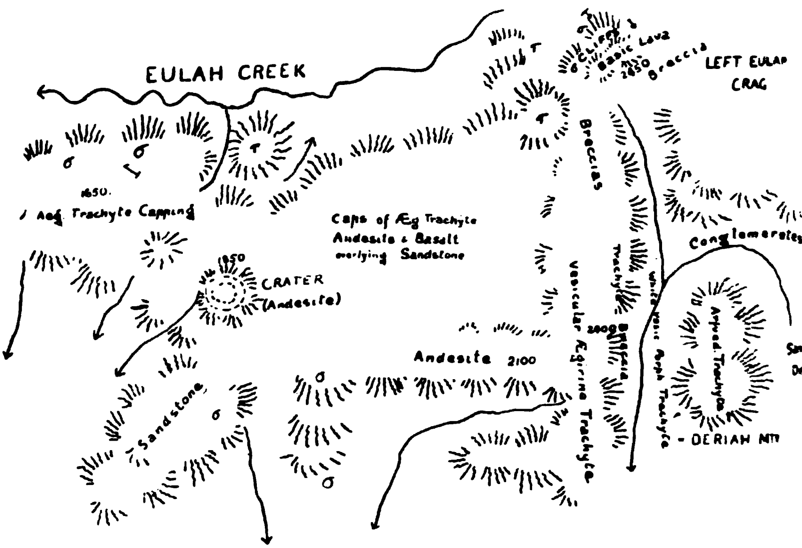

Fig. 8.—Plan of Country round Mt. Deriah.

Bobbiwaa Creek is separated from Spring Creek by a razorback spur similar to that which separates Spring Creek and Bullawa Creek; but, unlike the other creeks dealt with, it flows in a broad plain-like valley, three or four miles wide as far up as Dripping Rock, and a few miles lower down it leaves the mountain altogether. The hills facing Bobbiwaa Creek in its upper reaches are not cliffs, hence the valley is nowhere cañon-like. In fact, this creek forms a natural gap between the volcanic masses north and south of it. The country between Bobbiwaa

Creek and Grattai (Couradda) is as rugged as that of Bullawa Creek, but the creek valley itself is a plain. Its level nature is apparently due to the fact that it was already a deep, broad valley when the eruptions took place, and though lavas entered it both north and south they by no means sufficed to fill it. This conclusion is borne out by the existence of volcanic trachytes at the level of the creek below Dripping Rock. The range between Rocky Creek and Bobbiwaa Creek has isolated trachyte cappings which are flows from dykes, but where the road crosses it there is no such cap (altitude 2,200 feet). It has been removed by denudation. The strata at the pass consist of Permo-Carboniferous sandstones and shales with a coal seam about 6 feet thick outcropping on the top. The dip appears to be S.E. at angles not exceeding 10°. A great laccolitic mass of basic rock similar to that at Dingo Creek and exhibiting similar variations intrudes the Permo-Carboniferous strata at the head of Bobbiwaa Creek, and attains a thickness of 400 feet. The numerous mountains (Dripping Rock, Grattai, etc.) lying north of Upper Bobbiwaa Creek consist partly of sandstones with basic sills and partly of sandstone with trachyte sills and flows. Some of the peaks are wholly composed of trachyte. The cappings of columnar trachyte all slope to the N.W., indicating an original slope in that direction before the outpourings, or that the flows came from the S.E., near the head of Bobbiwaa Creek. Across the range in the Rocky Creek valley the country is mountainous but not rugged. It consists essentially of Permo-Carboniferous rocks with basic sills and later trachyte dykes.

Maule's Creek.—The country surrounding this creek must also be dealt with separately. To Maule's Creek I proceeded from Tarriaro and struck the creek a few miles below its junction with Horse-Arm Creek. Between Tarriaro and this junction the country is sandy, very gently undulating, on the whole poor, and traversed by a number of shallow gullies heading in the mountains to the north-east; the gullies are devoid of water except when torrential rains occur and send the water down in sheets. Many of these watercourses are purely relics from a time when

the mountains stood higher and had a greater rainfall. Abrupt sandstone cliffs facing the S.W., and situated where Bibbla Creek and Deriah Creek leave the mountains, are seen from Tarriaro. This portion of the country is marked on the Government Geological Map of New South Wales as Triassic.

Black Mountain is shown on the Government Geological Map as consisting of acid igneous rock. On my map (Plate xlvii.) I have taken this for granted, although in ascending the mountain from the south I saw only sandstones and conglomerates with a basalt sheet on top. I saw, however, some loose fragments of a dioritic rock, which must be derived from an outcrop near by.

All the mountains between Black Mountain and Deriah present the same features, and consist probably of sandstones, conglomerates and shales of Upper Coal Measure and Trias-Jura formations with basalt sheets on top.

About 1½ miles south of Maule's Creek, near Laird's place (Berrioye Station); there is a ridge of hills running N.W.-S.E. (Long Plain Mountain). It consists of conglomerate made up chiefly of rhyolite pebbles. Mr. Laird has found fossil leaves in ironstones associated with these conglomerates, and his description of them answers to that of Glossopteris, so that the conglomerate must be Permo-Carboniferous, and the rhyolites from which the pebbles in them are derived must therefore be older. The pebbles of Maule's Creek consist of rhyolite chiefly, with a little granite, basalt and trachyte. In Horse-Arm Creek the pebbles are mostly of basalt, sandstone and trachyte.

The average height of the hills (mesas) north and south of Maule's Creek in this region (*i.e.*, between Horse-Arm Creek, Pinnacle Creek, and Stony Creek, Berrioye Station) is 1,400 feet, increasing towards the north and diminishing towards the S.W. At Buron Creek conglomerates of Permo-Carboniferous age are observed dipping N.W. On the Coolah side of this creek the valley of Maule's Creek becomes a gorge with high hills fronted with cliffs and escarpments on both sides, while down stream Maule's Creek flows in a broad valley—a perfect plain continuous with the Tarriaro and Narrabri plains—and delimited on the

north and south by mesas several miles removed from the creek. This Maule's Creek plain marks an area of undoubted Permo-Carboniferous age. It is well-grassed and timbered, box trees, an indication of good soil, being abundant. The mesas north and south of it are probably chiefly of Upper Permo-Carboniferous age, but of Trias-Jura age in places, especially between Black Mountain and Deriah. The sandstones of the mesas are composed chiefly of quartz sand and the conglomerates of quartz pebbles, and the vegetation is very poor. The Lower Permo-Carboniferous sandstones and conglomerates give a much better soil, containing much felspar of rhyolitic origin.

In the gorge above its junction with Buron Creek, Maule's Creek has cut through a series of conglomerates composed of rhyolite pebbles like those of Berrioye, but having, nevertheless, a totally different appearance—being, in fact, boulder beds, containing boulders up to two feet in diameter. They are chiefly tilted in places and exceed 1,000 feet in thickness. On the Government Geological Map this area is put down as Carboniferous, an estimate which appears to me to be correct. Mount Byar and Mount Coolah are composed of massive conglomerates with interbedded sheets of tuff and rhyolite (quartz porphyry), the pebbles of the conglomerate being identical in nature with the interbedded sheets. Above Coolah Station on Maule's Creek and its branch, Oakey Creek, similar rocks occur, but near Waterloo Pinnacle cherts and slates are met with in the hill-slopes. They are highly metamorphic, and sills or dykes of orthoclase quartz porphyry intrude them. They are probably Devonian, and the whole series here seems to dip E. at 20°.

The rocks of Byar and Coolah Mountains on the other hand have a N.W. dip at angles up to 20°. The Pinnacles, a couple of peaks north of Coolah, are remarkable for being as rugged and precipitous as trachyte plugs. I went to them expecting to find them composed of trachyte, but to my astonishment they consisted of Carboniferous conglomerate similar to Byar Mountain, dipping N.W. at 20°. The dips around Coolah Station are

not very reliable, at any rate the time I spent in the vicinity was not sufficient to work them out properly. The confusion is due to (a) the extraordinary conditions under which the conglomerates were formed, (b) subsequent quartz porphyry intrusions, (c) mountain-building movements. However, speaking generally, the rocks S.S.E. of Upper Maule's Creek and its branch, Oakey Creek, dip in an easterly direction, whilst those west of them dip N.W., so that these two creeks occupy the position of the crest of an anticline, or perhaps the line of junction of Devonian and Carboniferous rocks. The latter hypothesis is the less probable, as the rocks on both sides of the line are very similar.

Between Coolah Station and Boggabri the country is studded with mesas and mesa-like ridges of barren sandstone. Near Boggabri buttes of rhyolitic lava and tuff become abundant. To the south of Boggabri, between it and Gunnedah, the formation is Permo-Carboniferous sandstone capped with alluvial in places. West of Boggabri lies the Pilliga Scrub, in Upper Coal Measure country, composed of very barren sandstones. Between Narrabri and Boggabri the same formations occur. On the road, about half-way between the towns, some large basaltic sheets are crossed; further north, at Tipperina, the road passes through an edge of the Pilliga Scrub (sand).

Seen from Maule's Creek plain or from Boggabri, the Nandewar Range south of Coolah presents the remarkable appearance of being capped with peaks which all have a steep slope to the south and a gentle slope to the north. The only explanation which I can suggest to account for the phenomenon is that there may have been step-faulting with the downthrow of the southern wall in each case.

The Manilla Range west of Boggabri I did not find time to visit, but judging by its rugged appearance it is probably composed of volcanic rocks, in all probability rhyolite.

4. Geomorphogeny.

(a) *General Discussion.*—From the foregoing description we see that the Nandewars, like the Warrumbungles, may be looked

upon as a conoplain, which is composed of sedimentary strata intruded by sills and capped with volcanic rocks, and has been dissected by semi-arid agencies. The gorge-like valleys in the mountains with vertically retreating cliffs, the steep shingle-covered slopes, the want of definiteness in the watercourses when they leave the mountains, and many other features are characteristic of an arid cycle. This country did not have much appearance of aridity at the time of my investigations. On the contrary, it was covered with waving fields of wheat and high grass, and rains occurred almost daily. However, it must be borne in mind that any area in which the rain falls principally at certain times in the year, the wet season, and then falls in torrents, whilst other periods, the dry seasons, extend over most of the year, and in which prolonged droughts occur, has the arid cycle characteristics and is classed with arid regions. Round the Nandewars on the west and south we have mesas of sandstone which show a N.W. dip. These are probably of Trias-Jura age, but may be Upper Permo-Carboniferous.

Mount Kaputar is the apex of the Nandewar Mountain mass. The mountain group is not round but oval with the long axis N.N.W.-S.S.E. It is composed of two definite masses, one north and one south of Bobbiwaa Creek. The highest peaks of the northern do not greatly exceed 3,000 feet in altitude. They are Dripping Creek (or Castle-Top), Grattai (Couradda), Terrergee, and others. The peaks of the southern mass are much higher, many exceeding 4,500 feet; Kaputar, the highest, is 5,000 feet high. Bullawa Creek divides the southern mass into two divisions, the northern of which is very dissected, whilst the southern is a compact tableland. On the large tableland are the curious tower-shaped peaks of Corrunbralborawah, Ningadhun, etc., and the long razorback dykes, like Yullundunida, which indicate late intrusions of hard trachyte into softer tuffs or andesitic lavas that have more easily been denuded away. Remnants of crater-rings are abundant but not very definite. One fairly definite basaltic crater has been noticed south of Eulah Creek. Ningadhun is probably a plug injected into the

neck of a volcano,* and the high conical mass north of it is a similar plug in a parasitic vent. In American phraseology, these plugs may be termed buttes.

The wide Black Soil Plains expanses of Bobbiwaa Creek and Maule's Creek, with so gentle a slope towards the general plains of Narrabri and Tarriaro that the country might be said to be practically level, show clearly that a previous wet cycle cut gorges in the elevated conoplain and carved wide valleys. Then followed an arid cycle with disintegrated drainage, the result of which was the filling of the valleys with the detritus; lastly there has been a return of slightly moister conditions, hence there is a tendency for the drainage to become integrated again and for the creeks to become rejuvenated. The formation of black soil plains and the subsequent rejuvenation of the streams may bear a relation to the formation of a lake in the north-western districts of New South Wales and its subsequent drainage through its waters finding an exit by way of the Murray River. The arid period probably followed this last event.

(b) *Geological History.*—The geological history might be summed up as follows:—In the Carboniferous period the area of the Nandewar Mountains and the country to the north-west of them consisted of dry land on which Silurian, Devonian and older rocks were undergoing corrasion and denudation. The detritus was carried eastwards and southwards to a Carboniferous sea of which good evidence is seen at Maule's Creek. This sea extended westwards over the Barraba, Cobbadah, and Bingera districts as far as New England. Volcanic eruptions of an acid nature took place at the time—often in the sea or along the coast-line, so that on the shore huge pebbles and boulders of rhyolite accumulated. Eruptions took place at frequent intervals, so that we find tuffy sandstones and conglomerates, boulder beds with a volcanic ash matrix, and occasionally lavas all interbedded with one another. These eruptions were accompanied

* *Cp.* 'Geology of The East Moreton,' etc., These Proceedings, 1906, p.97.

and followed by the elevation of the marine area and the subsidence of the continental area westwards. Hence a considerable thickness of coarse conglomerates and boulder-bearing tuffs was formed. At Coolah Station they are over 1,000 feet thick. By the middle of the Permo-Carboniferous period the continental area had been depressed beneath sea-level and sediments began to accumulate there. They are universally of shallow-water, estuarine, and lacustrine origin, comprising sandstone, conglomerate, grit, Glossopteris shales and coal-seams. No marine fossils have been observed. The grits and sandstones were derived from the denudation of rhyolites and granites which were now undergoing weathering in the elevated regions to the north and east. There is a distinct unconformity between Permo-Carboniferous and Carboniferous beds at Maule's Creek. Those of Carboniferous age are more highly folded, often faulted, and have interbedded igneous rocks derived from contemporaneous volcanic action.

Trias-Jura sedimentation followed Permo-Carboniferous. Subsequent to this came the folding of the deposits, from the S.S.W., against the New England massive. Elevation took place. The uplift was probably contemporaneous with one in New England which preceded the Mole Cycle.* The uplift in the Nandewar region probably gave rise to a gentle fold running N.N.W.-S.S.E. locating the mountain axis. Laccolitic injections of basic rock (olivine dolerite, etc.) took place at the same time (probably Cretaceous). Base-levelling to the level of the western Cretaceous sea left a peneplain with a gentle slope to the west; its level in the Nandewar Mountains is marked by the flat-topped sandstone mesas averaging about 1,400 feet in altitude.

Further earth-movements of late Cretaceous or more probably of early Tertiary age, coincident with the Tertiary elevation of New England (introducing the Stannifer Cycle) in which Bingera and Barraba districts shared, seem to have given rise to a fault.

* Andrews, 'Tertiary History of New England,' Records Geol. Surv. N. S. Wales, Vol. vii.

The western side was thrown down, so that lavas flowing from the main fissure poured chiefly westwards. The eruptive and intrusive (sill) materials from the main fissure and from intersecting secondary cracks gave rise to the lava dome.

Mr. Andrews has shown that the New England and adjoining areas underwent rapid elevation in the late Cretaceous and early Tertiary periods, and were at the same time suffering rapid denudation. At the same time the west of New South Wales was being loaded with sediments. The Nandewars lie on the border of these two zones. Probably strain caused by the differential movement on either side was an important cause of faulting.

The downthrow of the western and elevation of the eastern side of the fault have tended to preserve relics of Triassic and upper Permo-Carboniferous rocks west of the fault and to expose Carboniferous and Devonian rocks east of it.

Tertiary denudation has dissected the conoplain established at the end of the volcanic cycle, and the products of erosion have been deposited (aggradation) in a depression formed by faulting, so that a thickness of over a thousand feet of soft Tertiary rock and alluvium has been formed at Narrabri. The Namoi River has also helped to aggrade the depression.

(c) *Volcanic Action.*—The order of eruption, judging by field observations, seems to have been as follows:—

(1) Pre-Tertiary, probably early Cretaceous, basic intrusions in Permo-Carboniferous strata.

(2) Tertiary: (*a*) Sill-like and laccolitic intrusions of syenite accompanied by flows of phonolite, trachyte, and allied alkaline lavas. (*b*) Alkaline andesites and more porphyry sills. (*c*) Basic porphyrite dykes and basalt flows.

The basaltic eruptions probably lasted well into the Miocene and Pliocene periods. The volcanic period was an era of great uplifts caused by the injection of sills and laccolites. The uplifts led to changes of dip in the sedimentary rocks and disturbed the uniformity of the Mole level in the region, considerably increasing it towards the centre of the group.

Considering all the igneous rocks of the Nandewar Mountains, we have to add the rhyolites and quartz-porphyries lying south-west and west of the group. These were of Devonian and Carboniferous age, and closely resemble lithologically the Snowy River porphyries.

The relative ages of the various igneous rocks have been determined as follows :—

(1) Rhyolitic tuffs occur in the Carboniferous sediments, and rhyolitic pebbles occur in Permo-Carboniferous sandstone conglomerates. The rhyolite therefore antedates the Permo-Carboniferous.

(2) The basic laccolites intrude the Permo-Carboniferous, but are cut by trachyte dykes. They have formed at a considerable depth, hence before the dissection of the Mole peneplain. They must therefore be Triassic or early Cretaceous; for reasons advanced above, probably the latter. They may even be of the same age as the basic granites and intermediate rocks of New England.

(3) The trachytes intrude Permo-Carboniferous rocks and the later basic laccolites. Lithologically they are identical with the trachytes of the Warrumbungle Mountains and Glass House Mountains. In the absence of evidence to the contrary and in the presence of indirect evidence (drawn from plateau-erosion) in favour of the supposition, the same age, namely Eocene, must be assigned. They may be divided into two series :—

(1) Light grey trachytes, arfvedsonite trachytes, and rhyolitic trachytes, and syenite of a pepper-and-salt colour in sills and laccolites.

(2) Dark green ægirine trachytes (phonolitic) and sills of ægirine-augite syenite and of alkaline plagioclase porphyrites often containing fine-grained inclusions of phonolite of allied composition.

The second series is later than the first.

(3) The andesites form a connecting link between the ægirine trachytes and the basalts and grade into both. Many of the andesites are alkaline allied to phonolites.

(4) Basaltic eruptions came last, and the lavas are so rich in phenocrysts of an extraordinary size that cooling must have proceeded for some time at a depth. This phenomenon is also observed in the intermediate lavas (*cp.* the labradorite porphyrite, N.12).

Postbasaltic denudation has succeeded in carving the gorge-like valleys and in exposing volcanic plugs and dykes on the tableland, in removing crater-rings and in dissecting the semi-igneous mass. The original continuity of the tops of the spurs is shown by the volcanic rocks capping sandstones at the same level on either side of each valley at a height of many hundred or even 1,000 feet, and by the cappings of igneous rock on isolated sandstone mesas.

The irregularity of the lava-level in many places points to another significant feature, namely, that the area over which the lava flowed (the Mole peneplain ?) was at the time considerably dissected. Absence of marine fossils shows that it was land at the time of the eruptions.

It should be here again mentioned that around Boggabri there are numerous rhyolitic pinnacles which are probably of Tertiary age, contemporaneous with the Nandewar rhyolitic trachytes. They may, however, be older.

In the Pilliga Scrub, between Boggabri and the Warrumbungle Mountains, there are numerous conical peaks of andesite, probably of the same age. These igneous rocks serve to connect up the two volcanic regions, and show that the fractures in early Tertiary time roughly followed the border of the great Triassic basin.

(d) *Stream-Development.*—The nature of the Namoi River has already been discussed in my paper on the Warrumbungle Mountains. All the creeks rising in the Nandewar Mountains have their courses determined by the original slope of the conoplain, and are hence consequent streams. The evidence which they afford of a previous wet and a later arid cycle has already been discussed.

(e) *Present Changes.*—A recent rejuvenation is noticeable in some streams like Maule's Creek. This appears to be due to a gradual disappearance of arid conditions.

Volcanic activity has been long extinct, and there is no likelihood of its recurrence for many periods. The mountains are being base-levelled to the level of the western plains by the slow process of arid erosion. It is worthy of mention that, in addition to the other evidences of arid erosion already enumerated, many peaks in the vicinity of Dripping Rock, near Bobbiwaa Creek, display a very marked serrate topography. This characteristic I have not noticed elsewhere, and it is very striking.

5. Springs and Artesian Water.

Like the Warrumbungles, the Nandewar Mountains have many springs at high altitudes. Most of the important mountain springs flowed without intermission throughout the great drought, 1896-1902, when the creeks were all dry. Mr. Ritter told me of one spring near Pound Mountain which increased in strength during the drought to such an extent that the water rose in a fountain-like jet as thick as a man's arm.

The creeks dwindle enormously in size on reaching the plains west of the Nandewars. The reason of this phenomenon is that the water is absorbed by the great thickness of sandy alluvials which flank the Namoi for miles on either side.

Though many mesas south and south-west of the Nandewars are probably referable to the Trias-Jura, the sandstones underlying the alluvials of the plains in this quarter are mainly Permo-Carboniferous, hence the area is non-artesian. Some miles north of Narrabri, however, that is north-west of the Nandewars, there are sandstones which may belong to the Triassic intake beds of the artesian system.

6. Minerals of Economic Value.

The Nandewar Mountains, like the Warrumbungles, abound in veins of "potch" (poor opal) which occasionally contain specks of precious opal. The indications of precious opal are, however,

as far as I have seen, not so good in this area as in the Warrumbungles.

Beautiful veins of chalcedony and agate abound, especially in connection with vesicular volcanic rocks.

Small diamonds have been obtained at the Alpha Mine near Bullawa Creek in gravel near a basalt dyke. It is possible that the basalt may have been the matrix, having absorbed the carbon from underlying coal seams. Rocks like the Enstatite-peridotite-lamprophyre (N.18, p.884) which are extremely basic, very rich in iron and magnesia, and intruded along coal seams, might easily absorb carbon and liberate it again in the form of diamond on cooling.

Coal seams have been observed in many places. In the area abounding in sills, such as around Bullawa and Eulah Creeks, the coal seams have in most cases been destroyed. On the summit of the divide between Rocky Creek and Bobbiwaa Creek there is, as already mentioned, a seam of good coal about 6 feet thick. No doubt in time to come many valuable coal seams will be found and worked in the area surrounding the mountains.

I have not noticed any diatomaceous earth deposits in the portions of the Nandewar Mountains which I investigated, but diatomaceous earths have been recorded from the vicinity of Barraba, south-east of the mountains, by Mr. E. F. Pittman.*

Other Alkaline Areas.

From the foregoing notes it is apparent that the two great volcanic areas of the Nandewar and Warrumbungle Mountains consist mainly of alkaline igneous rock varying greatly in basicity. Between them there are scattered masses of rhyolitic, phonolitic, and andesitic rock which form a chain connecting the two areas.

Similar scattered pinnacles and cones occur at intervals between the south-west corner of the Warrumbungles and Dubbo. This area is referred to the Upper Coal Measures on the Geological Survey Map, but on closer investigation much of it will probably

* Ann. Rept. Dept. Mines, 1881, pp.142-143. By authority, Sydney 1882.

be found to be Trias-Jura. In the first place, most of the sandstone between the Castlereagh River and the Warrumbungles has the appearance of being Triassic. The range lying between the Castlereagh and the Talbragar Rivers is probably also Triassic, the valleys only belonging to the Coal Measures.

Around Dubbo, to which I drove from Coonabarabran viâ Mundooran and Cobborah, there are Triassic rocks containing good imprints of *Thinnfeldia odontopteroides*: the best fossils were obtained at a well about 2 miles S.S.W. of Dubbo on the Peak Hill road. Further down, about 5 or 6 miles S.S.W. of Dubbo and about halfway between the Peak Hill and Obley roads, I examined some hills locally known as the Gibraltar Rocks. These consist of a grey, pepper-and-salt-coloured sanidine trachyte containing magnetite, arfvedsonite, and ægirine. It intrudes Triassic sandstone and the adjoining quartz-porphyries.

The occurrence of trachytes near Dubbo was first noted in 1905 by Mr. J. Murton, Geological Surveyor. Mr. W. S. Card has kindly supplied me with a specimen of the arfvedsonite trachyte found by Mr. Murton in the Parish of Dungarry near Dubbo. Its chemical analysis (by Mr. B. White) is quoted in my paper on the Warrumbungle Mountains.

Mr. Staff-Surveyor Thomas, of Dubbo, informs me that there are other knobs of trachyte at Minore, N.N.W. of Dubbo. Others occur S.E. of the Gibraltar group; probably therefore there is a string of these alkaline trachyte knobs connecting up the Warrumbungles and the Canoblas.

Mr. Card has lately received other interesting specimens from Mr. Murton, including specimens of nepheline syenite, nepheline phonolite.*

The Barrigan mass of tinguaite, referred to in Carne's 'Monograph on the Torbanite of New South Wales,' (Mem. Geol. Surv. N.S. Wales) though of a similar age to the alkaline rocks above dealt with, does not lie on the same curve. The masses dealt with lie

* "Miaskose," see 'Petrological and Mineralogical Notes,' No.10. Records Geol. Surv. N. S. Wales, Vol.viii.

on a line which runs S.W. from the Nandewars to the Warrumbungles, thence S.S.W. to Dubbo and Minore, thence S.E. to the Canoblas, and continues in the same direction to Mittagong, with outlying extrusions of a dark green variety as far west as Goulburn. It is likely that other alkaline trachytes and allied lavas will be met with between Barrigan and the Nandewars, and between Barrigan and Mittagong. If so, the belt of alkaline lavas forms a loop round the Gunnedah basin of Upper Coal Measure strata. The significance of this matter I propose to discuss more fully in a later paper.

It is also interesting to note that some considerable masses of fine limonite, iron ore, occur on Doyle's farm near Gibraltar close to Dubbo. On the Coonabarabran-Cobborah road, not far from Mundooran, some of the sandstones are so indurated with iron, in the form of hæmatite, that they could be smelted for iron. I have already mentioned that valuable deposits of a similar nature occur round the Warrumbungle Mountains. There is no doubt that in time all these districts will be worked for iron.

The origin or source of the iron I have not investigated, but as it occurs most frequently in the vicinity of igneous rocks it may have been derived from them by leaching, like the iron ores similarly situated near Mittagong.*

B. Petrology.

The rocks of the Nandewar Mountains may be divided into A. *The Volcanic Series*, consisting of:—

- (a) Ali-rhyolites (alkaline rhyolites), including comendite and quartz pantellarite.
- (b) Ali-trachytes (alkaline trachytes), including soda-trachyte, pantellarite, &c.
- (c) Phonolites.
- (d) Alkaline andesites.
- (e) Alkaline basalts.
- (f) Calcic rhyolites and basalts.

* Taylor, T. Griffith, and Mawson, D., 'The Geology of Mittagong,' Journ. Proc. Roy. Soc. New South Wales, Vol. xxxvii.

Of these subdivisions the first two have very many minerals in common, and show other points of similarity. The next three divisions are also closely related to one another, numerous intermediate forms linking them. They are also related to (a) and (b). The last subdivision has no relationship at all to the others.

B. *The Hypabyssal Series*, consisting of :—

(a) Ali-syenite-porphyries (alkaline syenite-porphyries), including syenite-porphyry, ceratophyre, bostonite, sölvsbergite, grorudite.

(b) Felspathoid rocks such as pulaskite-porphyry.

(c) Augite-porphyrites and teschenites.

(d) Bronzite-peridote-porphyrites (monchiquitic lamprophyre).

Subdivisions (a) and (b) of the Hypabyssal Series are closely related to one another, but not to (c) and (d). The intrusions of the last two rock-types are later than Permo-Carboniferous, and probably also Post-Triassic, but not Post-Cretaceous, for they are nowhere seen interbedded with or capping sediments of Cretaceous age; but we find them underlying the fluviatile deposits of the Namoi at the Narrabri bore, and these deposits probably commenced to form in the Cretaceous. Again, eroded masses of them are met with at the level of the Cretaceous peneplain (Mole Cycle), but the lavas and tuffs of these rocks have been denuded away and only the hypabyssal forms left.

All the other rocks described from this region, both hypabyssal and volcanic, with the exception of the Carboniferous rhyolites and rhyolitic tuffs of Maule's Creek, and perhaps the Boggabri rhyolites, may be looked upon as differentiation-products of the same magma. The Boggabri rhyolites, tuffs and pitchstones are doubtful both as to age and relationship.

The latest basalts in the Nandewars are calcic, but often free of olivine, and are best looked upon as the basic residuum of an alkaline magma.

The augite-porphyrites and bronzite-porphyrites of Cretaceous age are often rich in analcite, and may therefore also be related to the alkaline series, but this is extremely doubtful.

Minerals of The Nandewar Rocks.

i. The Ali-trachytes, Ali-rhyolites, Bostonites, and related porphyries contain many minerals in common.

(a) Abundant or common.—*Felspar* occurs in phenocrysts and also finely granulitic in the base. The phenocrysts are usually bounded by the faces *m* (110), *a* (100), *n* (021), and *b* (010). Sometimes they are tabular parallel to *b* (010), which is the typical sanidine habit, and have the usual crosscracks developed. Sometimes they are prismatic, thickened also in the *c* direction; $\dot{a}$ (crystallographic) is the usual direction of elongation. Carlsbad twinning is generally observed, but in some rocks the Baveno type is even more frequent. Manebach twinning sometimes occurs. There are, therefore, Baveno twins forming nearly square prisms elongated in the direction of crystallographic *a*, Baveno twins tabular parallel to *b*, prismatic Carlsbad twins, and Carlsbad twins tabular parallel to *b*. In some Carlsbad twins the faces *x* and *c* are well developed (N.30). Inclusions of albite and of groundmass are occasionally seen in the phenocrysts of some rocks (*e.g.*, N.30); in others it is not unusual to find inclusions of quartz in them, in others again, microperthitic intergrowths of potash and soda felspar or cryptographic intergrowths of quartz and felspar.

In the Dingo Creek *Bostonite*, N.51, the extinction angle is from 8° to 11° on crystallographic $\dot{a}$ (edge *b c*), indicating a variety of sanidine rich in soda. The form of the crystals is tabular or elongated in the $\dot{a}$ direction. The extinction is shadowy, indicating ultramicroscopic twinning. Inclusions of quartz and apatite occur within the phenocrysts. By picking a section cut nearly parallel to the plane of the optic axis it was ascertained by use of the selenite plate that $\mathfrak{a}$ is near a normal to the $\dot{a}$ axis. The square sections (*i.e.*, sections at right angles to *a*, the direction of elongation) showed an axial cross in the same slide. Therefore

$$Bx^a = \dot{a}, \textit{ i.e}, \text{ nearly at right angles to } \mathfrak{a}.$$

These crystals are therefore negative. They must be looked upon as a variety of sanidine very rich in soda.

Associated with such phenocrysts in the same and other rocks occur Carlsbad twins of similar habit, in which it was determined with the selenite plate that

$$Bx_{a} = \mathfrak{a}.$$

These crystals are therefore positive and must be looked upon as a variety of anorthoclase closely related to albite.

Hence we have in general two types of felspar phenocrysts.

Optically positive, usually prismatic, crystals of the sanidine habits with a refractive index less than canada balsam, Carlsbad or Baveno twinning, cleavage parallel to *c* and almost at right angles to *b*, and extinction angle from 0°-12° on edge *b c*. This felspar is a variety of anorthoclase in which the albite molecule predominates.

Optically negative crystals either prismatic with square sections or tabular parallel to *a*, showing Carlsbad or Baveno twinning. Their extinction angles vary from 0°-10° on the edge *b c*. They are clear and furnished with crosscracks like sanidine. This felspar is assignable to the species of orthoclase (sanidine) and anorthoclase sanidine. Albite inclusions are common.

These two forms may occur together in the same rock or intergrown in the same crystal, and numerous intermediate types exist.

The felspars of the base are referable in different rocks to different species varying from pure sanidine to albite. Usually the predominating felspar of the phenocrysts is abundant or predominating also in the base.

Hornblende occurs sometimes in rods, sometimes in minute grains clumped together in dendritic aggregates forming a poikilitic intergrowth with felspar. It is frequently replaced by hæmatite and occasionally in weathered rocks by limonite. It has the usual appearance of the arfvedsonite already described in the paper dealing with the Warrumbungle Mountains.

In N.46, a rock rich in blue amphibole and very poor in ægirine, it was ascertained that in the blue amphibole $Bx_{a} = \mathfrak{c}$, hence the mineral is positive. The extinction was nearly straight and the absorption scheme proved to be

$\mathfrak{c}$ (deep blue-black) $>$ $\mathfrak{b}$ (lavender) $>$ $\mathfrak{a}$ (bright light green).

N.59 B is a rock in which nuclei of dark arfvedsonite or riebeckite of a deep blue-black colour are surrounded by a lighter-coloured arfvedsonite or ægirine, sometimes the one, sometimes the other. The dark arfvedsonite is like that of N 46; ægirine is the dominant ferric mineral. The light-coloured variety of arfvedsonite, however, displays peculiar properties. $Bx_a = \mathfrak{a}$, hence it is negative, and the absorption is

$\mathfrak{c}$ (bright greenish-blue .> $\mathfrak{b}$ (lavender) .> $\mathfrak{a}$ (greenish-yellow).

Possibly this mineral may be an aberrant variety of ægirite.

Pyroxene varies from pure ægirine to ægirine-augite. It answers to descriptions given of the same mineral in the Warrumbungle Petrology.

(b) Minerals sparingly represented.—Many of these are represented only by grains of such minute size that it has not been found possible to make an exhaustive examination of optical properties.

Cossyrite (?) occurs very sparingly and is recognised in sections where it occurs in extremely fine-grained poikilitic aggregates, by its deep brown colour, strong pleochroism and cleavage angle of 65°.

Katophorite (?) occurs in dendritic aggregates of somewhat acicular crystals often surrounded by hæmatite or a zone of arfvedsonite and ægirite. This mineral is strongly pleochroic in colours of deep purple, red, fine deep red, brown, yellow, and greenish-yellow. There are apparently several varieties graduating into arfvedsonite, cossyrite and ferrite. This mineral commonly forms only the kernel of crystals of ægirite and arfvedsonite. It appears to me for this reason that the arfvedsonite and ægirite are products of pneumatolysis commencing after the brown hornblendes had commenced to form. This vapour-action often completely decomposed the original katophorite, leaving ferric oxite (ferrite) in its place, and the Na_2O, SiO_2, TiO_2, etc., of the molecule were redistributed amongst other minerals of the rock. Only in this way can I explain that we often meet with

sheets of trachyte with the hornblende completely metamorphosed to ferrite or hæmatite while it has not been subjected to any more weathering than adjoining arfvedsonite trachytes.

Wöhlerite (?), a yellow mineral in acicular crystals, nonpleochroic or but slightly so; double refraction strong; refractive index medium. This mineral shows the characteristic yellow cracks of wöhlerite and is apparently the product of the pneumatolytic action which broke down the katophorite molecule. It is more abundant in ægirine-ferrite trachytes than in the rocks rich in arfvedsonite.

Lavenite (?) or Rosenbuschite (?) appears to be present in some of the rocks, but has not been identified with certainty.

Tridymite occurs occasionally in vesicles; often yellowish, almost isotropic opal is seen; occasionally banded chalcedony replaces it.

Meionite (?) (or an allied scapolite mineral such as wernerite or marialite) in clear glassy or milky-white crystals, showing a good cleavage, weak double refraction and medium refractive index, is sometimes present.

Where quartz is very rare or wholly absent, sodalite (or nosean), nepheline and katapleiite have occasionally been observed to occur.

In the phonolitic rocks of the Nandewar region we find, in addition to those occurring in the trachytes, nepheline, a mineral of the sodalite group, cancrinite, katapleiite (?), geisikite (?), liebnerite (?), zeolites and calcite. Analcite often occurs.

ii. The Ali-syenites, porphyries and porphyrites contain many of the above-mentioned minerals, but in the more basic varieties soda-lime felspars predominate as phenocrysts, and albite or potash-soda felspar (anorthoclase, soda-sanidine) in the groundmass. In different rocks different soda-lime felspars are met with varying from albite to medium labradorite.

In some reddish-coloured varieties of syenite-porphyry occurring in sills about Bullawa Creek the felspar phenocrysts have a refractive index less than canada balsam. In outline they are in some rock-varieties like orthoclase, in others they give rhombic sec-

tions (rhomben-porphyr). Twinning is on the Carlsbad plan, and the two cleavages are nearly at right angles to one another. In addition a fine striation due to polysynthetic twinning is readily observed. This felspar is a microcline microperthite (or anorthoclase microperthite). Often cloudy microcline (moirirten-microclin) and gitter microcline are abundant constituents. The base consists in these rocks essentially of anorthoclase. These soda-potash felspars, so common in the Christiania region, are extremely abundant and well developed in the Nandewar alkaline rocks.

Arfvedsonite is rare in these rocks, but occurs sometimes.

Ægirine is occasionally present, but more often it is represented by an ægirine-augite or light green diopside (salite). Olivine is never present, and in fact the analyses display so low a magnesia percentage that all this constituent must be incorporated in the ægirine-augite (see Analyses, Table i. and Calculations of the norm, Table ii.). The main bulk of these rocks consists invariably of felspar, the other constituents never attaining great abundance.

As minor constituents we find nepheline (in the groundmass), decomposition-products after nepheline such as cancrinite, katapleiite, geisikite (?), liebnerite (?) and zeolites; also apatite, fluorspar, zircon, ferrite, magnetite, hæmatite, ilmenite. Chlorite, secondary after ægirine-augite, is a common constituent in many of the darker porphyrites. Occasionally sodalite is present. Quartz may also occur.

iii. The post-trachytic basic lavas have many similarities with the phonolitic and other intermediate lavas, in texture, mineral composition, and chemical composition. They are poor in magnesian minerals, olivine being usually absent (*cp.* the basalt of the Sandilands Ranges, New England).

iv. The basic rocks of greater antiquity than the trachytes, namely the dolerites intruding the Permo-Carboniferous strata at Bullawa Creek and Bobbiwaa Creek, form a distinct group. The pyroxene is a deep brown highly pleochroic titaniferous augite accompanied by a diallage. Olivine is abundant, and the felspar is very calcic. Some of these rocks, however, contain

analcite in fair abundance, a fact which may be an indication that even then there was a tendency for this to be a sodic province.

N.62. Loc.: hill at junction of Manilla and Narrabri roads, 3½ miles north of Boggabri. Age uncertain. (Plate l., fig.1).

Handspecimen a dark green to black rock, showing fluxion structure and perlitic cracks. A few vesicles and idiomorphic phenocrysts of orthoclase, oligoclase and albite occur in it. This rock occurs in the form of a narrow dyke at the foot of the hill mentioned, which consists essentially of rhyolite and rhyolitic tuff.

Microscopic appearance: texture hypohyaline, porphyritic, with perlitic structure in the glassy base.

Constituents: the base which forms the bulk of the rock consists of a greenish glass showing beautiful perlitic cracks and groups of globulites. Scattered about in some abundance we find beautiful idiomorphic phenocrysts of felspar, some of which increase in basicity from the interior outwards. Often the core is orthoclase, an intermediate zone anorthoclase, and the outer zone albite or oligoclase. Neither in mineral composition nor in chemical composition does this rock show decided resemblance to the alkaline rocks of the Nandewars, yet it is not very distantly removed from them.

Name: Perlitic Pitchstone. Magmatic name, Riesenose (see Tables i. and ii.).

Note.—This rock is associated with holocrystalline, hemicrystalline and cryptocrystalline rhyolites.

N.67. Loc.: The Pinnacles; Maule's Creek. Age: Carboniferous.

Handspecimen a reddish conglomerate-like rock with both the rounded pebbles and the finer matrix consisting of rhyolitic material.

In section the pebbles were seen to consist of a normal rhyolite (quartz, orthoclase and a little chlorite) and to have been rounded by the action of water. The matrix consists of fragmentary grains of quartz and felspar and volcanic ash consisting of the

same minerals and a great abundance of glass fragments in the form of minute tubes, and boomerang-shaped and bone-shaped, branched and jagged rods. All this material is of pure volcanic origin, but has evidently been redistributed by the action of water. Subsequent alteration due to regional metamorphism has led to the commencement of secondary crystallisation or regeneration of crystals. Much of the material, originally glassy, is therefore partially devitrified.

Rocks of this kind, which must be termed *Tuffy Rhyolite Conglomerates*, prove without doubt that submarine eruptions and land eruptions were in progress near an old shoreline and the materials ejected were redistributed by the waves.

Interbedded with them are found rhyolites, devitrified porphyritic pitchstones and quartz porphyries.

N.17. Loc.: laccolite on Dingo Creek, branch of Bullawa Creek. (Plate l., fig.2).

Handspecimen a coarse-grained dolerite in some varieties of which large augite phenocrysts occur, but the type here described is rather even-grained. Near the edges of the laccolite this rock graduates into a black aphanitic basalt with occasional amygdules. The intrusion is older than the alkaline rocks.

Texture holocrystalline, seen under the microscope to be uneven-grained and porphyritic, having crystals of most varying sizes. Fabric hypidiomorphic granular, and ophitic.

Constituents: basic felspar and titaniferous augite are the two most abundant constituents, occurring in about equal proportions and forming about 60-70 % of the mass. The next constituent in order of abundance is olivine, forming between 10 % and 20 %. Then follow magnetite and ilmenite, forming upwards of 5 %. Decomposition-products such as serpentine, chlorite and leucoxene also occur in notable amount. As an accessory minor constituent apatite (in long thin needles penetrating the other minerals) deserves mention.

Note.—In some varieties of this rock-type analcite forms a constituent mineral.

Order of consolidation: felspar needles frequently penetrate some distance into augite crystals but never to the core.

{ Magnetite
{ Ilmenite
Olivine
Apatite
Augite
Felspar
(Analcite when present)

Name: Ophitic Olivine Dolerite or Diabase. Magmatic name, Kentallenose (see Tables i. and ii.).

Closely allied to N.17 is a rock from the Alpha (Diamond Mine, Bullawa Creek, 13 miles N.E. of Narrabri, N.S.W., of which the following description has been supplied to me by my old friend, Mr. G. Saunders, B.E.

Handspecimen resembles a basalt, being of a dark colour and moderately fine-grained. It occurs as a dyke about 8 feet wide. Bands of calcite occur in it, and due to these bands the rock crumbles away on exposure. It intrudes sandstone, and capping these rocks there is an alluvial deposit in which diamonds, sapphires, zircon and gold have been noticed.

Microscopic Description.—Texture holocrystalline; grainsize medium with a few large phenocrysts of augite and plagioclase; fabric camptonitic and ophitic.

Constituents in order of decreasing abundance are (1) felspar, (2) titaniferous augite, (3) colourless diopside in phenocrysts, (4) olivine, (5) serpentine, (6) magnetite, (7) grains of red olivine (fayalite), and (8) apatite.

I have examined a slide of it sent to me by Mr. Saunders, and I find it to be a rock closely related to N.17. The felspar is a basic labradorite, and it as well as the olivine and augite occur in two generations.

Mr. Saunders also kindly forwarded me a slide of another rock of the same kind obtained from a depth of 2,015 feet in the bore-hole at Narrabri. This rock is holocrystalline, hypidiomorphic granular, medium-grained, and porphyritic in augite, magnetite and felspar. The felspar consists of lath-shaped labradorite crystals; the augite is highly titaniferous and occurs in fine reddish-brown idiomorphic crystals which frequently enclose felspar in an ophitic manner. Titaniferous magnetite occurs in corroded phenocrysts; ilmenite is also present. Apatite is common as inclusions in both the augite and the felspar. Large patches of the base consist of a clear colourless isotropic mineral with a low refractive index. This mineral was the last to consolidate, and is probably analcite. The rest of the ground-mass consists of the second generation of the minerals already mentioned.

Name: Ophitic Analcite-Olivine-Dolerite or Diabase.

N.19. Loc.: edges of laccolite, Dingo Creek.

Handspecimen dark basaltic-looking rock with white amygdules.

Texture holocrystalline, uneven-grained but fine-grained with pilotaxitic fabric.

Composition: this rock consists of basic labradorite felspar in laths decomposing to analcite, zeolites and other products, automorphic but somewhat corroded grains of titaniferous augite, very corroded and rounded olivine grains, idiomorphic magnetite granules, analcite and decomposition-products. The white amygdules consist of analcite and zeolites.

Name: Pilotaxitic Olivine Basalt (or Diabase).

N.56 consists of a fine-grained basalt exactly like N.19, and occurs on the borders of the basic laccolite at the head of Bobbiwaa Creek.

N.57, collected from the core of the same Bobbiwaa laccolite, is a coarse-grained dolerite (or diabase) exactly like N. 17, described above.

Linking the foregoing basic rocks to the alkaline series are certain remarkable essexites, of which I have found rolled specimens in the creeks, but which I have not met with *in situ*.

N.28 is a reddish coarse-grained rock, in handspecimen not unlike N.27 (described hereafter). Loc.: Thor's Creek, Bullawa Creek.

Microscopic examination: Texture holocrystalline, hypidiomorphic granular, uneven-grained rock, showing ophitic structure.

Constituents (in order of decreasing abundance): (1) Titaniferous augite studded with interpenetrating felspar needles and apatite inclusions; it occurs in phenocrysts which are more or less corroded and fractured. (2) Bronzite with well-defined crystalline outlines. (3) Ilmenite. (4) Analcite (interstitial). (5) Chlorite replacing biotite. (6) Bytownite and anorthite felspar in laths. (7) A little biotite. (8) Apatite needles. (9) Zircon. (10) Zeolites of the mesolite group. (11) Interstitial orthoclase. (12) Serpentine in irregular patches.

Name: Ophitic Analcite Essexite allied to Teschenite.

Note.—This rock seems to have been formed by a kind of magmatic mixture of an alkaline rock with a dolerite like N.17. The mixture may have taken place either by an alkaline magma having intruded, partially fused and assimilated a dolerite, or wholly by pneumatolytic processes. The broken nature of the pyroxene phenocrysts and the irregular serpentine patches representing the remnants of resorbed olivines support the first supposition. The second alternative receives support from the facts that biotite has developed and analcite is abundant. When we consider the basicity of the felspar laths and their fresh appearance it becomes evident at the same time that the analcite could not have been primary, nor can it have been formed by decomposition of the felspar. Therefore it is concluded that the magmatic vapours from the alkaline intrusions caused a partial recrystallisation in this basic rock, introducing K_2O to form the interstitial orthoclase and biotite,

SiO_2 to change olivine to bronzite, and water to break up the original felspar molecules into anorthite and analcite. Zircon (ZrO_2) was introduced at the same time.

Taking all into consideration it appears that there was *magmatic mixing*, accompanied by *pneumatolytic action.*

N.18. Loc.: Sill iii. at Dingo Creek (Pl. lii., fig.1).

Macroscopic characters: the handspecimen (Pl. lii., fig.1*a-b*) presents a remarkable appearance. It is studded with gigantic phenocrysts and fragments of crystals of a black mineral with a dull lustre not unlike that of gadolinite. In general outline this mineral reminds one of cassiterite, but its good cleavage in three directions and its brittleness show that we have a pyroxenic mineral to deal with. In addition, the rock contains an abundance of fragments of crystalline aggregates, many of which have such regular and straight outlines as to be suggestive of pseudomorphs after olivine. One of the minerals composing the fragments is seen to be a green olivine. Many of the fragments are 1½ inches or more in length and over ½-inch in width. The black phenocrysts attain a length of 3 to 4 inches, and a diameter af 2½ to 3 inches. In addition we may notice phenocrysts (up to 1 inch in diameter) of a brown spinel, and a black microcrystalline groundmass.

The rock weathers to a reddish clay, and decomposing specimens have always a reddish crust of iron oxides. Occasionally large crystals of biotite (or paragonite) attaining a diameter of 1 to 1½ inches, and a thickness perpendicular to the cleavage of about ½-inch, are met with. Calcite or dolomite occurs abundantly, forming amygdules.

This rock forms a sill, having a thickness of about 3 feet, and dipping S.E. at 25° (S_1 fig.), capped by and overlying cherty, metamorphosed, Permo-Carboniferous shales containing *Glossopteris*, *Gangamopteris* and *Noeggerathiopsis.* Intruding the same shales about 30 feet higher up the series we have a sill of felspar porphyry with a trachytic matrix (bostonite). The succession of

strata observed from the bottom of the cliff to the top is seen in the following statement :—

Dip S.E. at 25°	Top of hill—	Trachyte under which we have conglomerate, thickness not estimated.	
	Top of cliff—	The same conglomerate.	
	Then—	Sandstone, 30 feet.	
		Cherty Mudstones, 20 feet.	
		Felspar Porphyry Sill (Bostonite), 6 feet.	
		Cherty Mudstone, 9 feet	With Permo-Carboniferous fossils.
		Soft Blue Shales, 6 feet	
		Cherty Shales, 4 feet	
		,, ,, 7 feet	
		Black Shale, 6 inches	
	Bottom of Cliff, Dingo Creek.	Sill with black phenocrysts and fragments, 2ft. 9in.,	
		then Sandstone, 3 feet.	
		White Shales, 1 foot.	
		Cherty Mudstones, thickness unknown.	
		Level of Creek.	

Microscopic examination : texture holocrystalline, extremely uneven-grained on account of the monstrous phenocrysts set in the microcrystalline base. The base is quite aphanitic, but with a $\frac{1}{4}$-inch objective it is resolved and appears to be holocrystalline with a camptonitic fabric.

Composition : the crystal aggregates or fragments are seen under the microscope to have a more broken outline than the handspecimen shows. They consist of olivine, light greenish diopside, enstatite and colourless augite in hypidiomorphic to allotriomorphic crystals, the whole aggregate having a hypidiomorphic granular texture. Between the crystals are strands of a white fibrous chloritic decomposition-product, apparently margarite. Fragments of picotite are also present. The black phenocrysts are somewhat corroded along the margin, having a resorption rim resembling the celyphitic border of garnet. They consist of a species of hypersthene or amblystegite. The mineral has three well marked cleavages, two of which are at right angles; there are also two pinacoidal partings to which extinction is parallel. The pleochroism is weak, and the double refraction is also weak, being about the same as that of labradorite.

The mineral was determined to be biaxial and optically negative with a dispersion less for red than for blue ($\rho < v$). The brown spinel which occurs in crystals and fragments of all sizes in both the inclusions and the base appears to be picotite. The brown mica which occasionally forms huge phenocrysts occurs also in minute grains in the base. The fine-grained base consists of allotriomorphic olivine and augite grains, picotite grains, a little biotite, all evidently xenogenic, and of autogenic minerals including laths and needles of brownish titaniferous augite, needles of colourless diopside, rutile in needles, zircon in grains, and felspar. Both albite and orthoclase occur, and in addition there is nepheline and analcite. These last four minerals mentioned were the last product of consolidation. Yet they have a strong tendency to idiomorphism, except the analcite which is mainly secondary.

To sum up: the specimen N.18 is a lamprophyric rock; it contains xenoliths of enstatite-peridotite, and xenocrysts of a species of rhombic pyroxene, of biotite (lepidomelane ?), of picotite, and of olivine and augite. The base has an almost panidiomorphic structure, the so-called camptonitic fabric, and contains, in addition to the xenocrysts, titaniferous augite, diopside, rutile, zircon, albite, orthoclase, nepheline and analcite, and possibly a little glass. The decomposition-products are margarite, bastite (schiller spar), serpentine and hæmatite. Calcite is particularly abundant, especially in the form of amygdules.

Name: Monchiquitic Lamprophyre. Magmatic name, Rossweinose (see Tables i. and ii.).

N.54. Loc.: hill on the Spring Creek Road, 2 miles N.W. of Narrabri.

Handspecimen has the appearance of typical porphyritic basalt. The age of the mass, which is associated with basic tuffs and breccias, is probably later than the alkaline series. This rock probably belongs to the late Tertiary—Pliocene—series of basaltic eruptions.

Texture almost holocrystalline, very uneven-grained, with hyalopilitic fabric.

Composition: the phenocrysts consist of basic andesine, olivine and greenish diopside. The felspars are sometimes zoned and show albite, pericline and Carlsbad twinning, and contain numerous inclusions of magnetite in glassy matrix. The olivines are slightly corroded, and the diopside is greatly corroded and resorbed.

The groundmass is even-grained and very fine-grained, and consists of felspar-laths (labradorite), augite of the second generation in idiomorphic grains, olivine grains, glass and hæmatite. The lastmentioned is an original constituent.

Name: Hyalopylitic Porphyritic Olivine Basalt.

The foregoing descriptions are of rocks which have no very marked relationship with the lavas of the alkaline series. All the other rocks about to be described from this area are closely interrelated and definitely fall into the alkaline division.

N.27. Loc.: Thor's Creek, branch of Bullawa Creek.

Handspecimen of a reddish colour not unlike N.28 already described, but the microscope reveals important differences.

Macroscopically it appears coarse-grained, but in reality it has a fine-grained base.

Texture holocrystalline, uneven-grained, porphyritic, with hypidiomorphic granular fabric.

Constituents: the phenocrysts consist chiefly of cloudy microcline and anorthoclase microperthite containing an abundance of inclusions of apatite and zircon. The microperthite felspar is commonly enveloped by a zone of pure orthoclase with straight extinction. Smaller phenocrysts of magnetite and hæmatite are also present.

The granulitic groundmass consists of orthoclase, nepheline, apatite, magnetite, hæmatite and other iron ores, yellowish-green pleochroic acmite, and rutile.

The apatite occurs in greenish-grey and bluish-grey idiomorphic hexagonal prisms capped with a pyramid at either end and longitudinally striated.

Rutile is abundantly represented in long microscopic needles. The nepheline is interstitial. A little wöhlerite (?) is also

present. The magnetite appears to be partly secondary after arfvedsonite.

Name: Nepheline-Acmite-Syenite Porphyry, allied to Sölvsbergite.

A rock closely allied to the preceding is N.8 (Pl.I., fig.3), which also occurs as a rolled specimen in Bullawa Creek. It is holocrystalline, porphyritic, with a fine-grained base, and has a trachytic fabric inclining to camptonitic.

The felspar phenocrysts have lozenge-shaped outlines in the sections like the felspar of rhomben-porphyr. They are twinned on the Carlsbad plan and exhibit a very fine polysynthetic twinning as well which shows that they belong to the species anorthoclase. The refractive index is less than that of canada balsam. Reddish iron ores (hæmatite) occur in dendritic aggregates secondary after a hornblende of the riebeckite group. The base consists essentially of lath-shaped microlites of sanidine, between which are studded minute stunted rods of ægirine, a little primary as well as secondary magnetite, and some interstitial quartz.

This rock is a somewhat decomposed sölvsbergite. It differs from N.27 mainly in that it is more decomposed and contains a little quartz instead of nepheline.

Still more closely allied to N.27 is another rolled specimen, N.9, from Thor's Creek. Its texture is the same. The phenocrysts consist chiefly of orthoclase, occasionally of microperthite. The orthoclase of the base is allotriomorphic in more or less rounded grains. There are numerous hæmatite or ferrite skeletons replacing what was originally a hornblende. Both idiomorphic primary, and dusty secondary, magnetite occur. Apatite is abundant and ægirine occurs sparingly in the base. The ægirine is of a bright malachite-green colour, strongly pleochroic, but of a colour so deep as to almost obscure birefringence.

This rock must be referred to the species Sölvsbergite.

N.11. Loc.: branch (E.) of Oakey Creek under Mount Odin. (Pl.I., fig.4).

Handspecimen: a dark greenish rock which on close inspection is readily seen to be porphyritic, although the phenocrysts are so dark in colour that they might easily escape notice at first glance. This rock occurs as a sill about 20 feet thick with Permo-Carboniferous Glossopteris shales and sandstones above and below.

Texture holocrystalline, porphyritic, with hypidiomorphic granular texture approaching the panallotriomorphic.

Constituents: the phenocrysts consist of felspar and diopside. The felspar phenocrysts are lozenge-shaped and consist of anorthoclase or microcline-microperthite enveloped by a zone of orthoclase. The inner portions have an extinction angle of about 10°, the outer zone having straight extinction. The refractive index of all parts is less than that of canada balsam. The diopside occurs in idiomorphic phenocrysts. In addition there are pseudomorphs after phenocrysts of hornblende. These usually consist of a brown ferrite skeleton enclosing a heterogeneous mass of secondary minerals, including chlorite, hæmatite, magnetite, sericite, some isotropic analcite or sodalite (?), and zeolites. They probably represent what was originally a brown soda-amphibole. Some of these pseudomorph phenocrysts contain small remnants of a reddish-brown very highly pleochroic mineral (apparently barkevicite).

The groundmass consists of orthoclase felspar, green ægirine-augite granules, nepheline and secondary minerals including chlorite and micaceous alteration-products after nepheline, such as geisikite, liebnerite, etc.

Apatite occurs sparingly as idiomorphic phenocrysts and also in smaller needles in the groundmass.

Name: Augite-Nepheline-Syenite-Porphyry or Pulaskite Porphyry. Magmatic name, Phlegrose (see Tables i. and ii.).

N.13. Loc.: This rock occurs as a fine-grained included mass of irregular shape and a couple of feet in thickness in the sill rock just described (N.11).

Handspecimen dark green, aphanitic.

Texture holocrystalline, microcrystalline, panidiomorphic granular.

Constituents: (1) lath-shaped crystals of labradorite (2) Ægirine in short prisms showing strong pleochroism in greens and blues, and straight extinction. (3) Idiomorphic prisms of nepheline and a minute quantity of the same mineral occurring interstitially. (4) Magnetite. (5) Decomposition-products including chlorite, pinite pseudomorphs and kaolin.

Name: Camptonitic Tinguaite.

This rock represents a fragment of the earliest consolidated portion of the magma torn from the walls of the reservoir by the rising lava.

Closely allied to this rock is a fine-grained nepheline phonolite found in a branch (B) of Oakey Creek (N.10). The acicular felspars are somewhat decomposed and consist of orthoclase and albite. Nepheline occurs in the groundmass. The femic constituent is a green nonpleochroic augite with very oblique extinction (about 46°, probably salite); it is surrounded by dark borders. Dusty magnetite, secondary after an amphibole, occurs, as well as other decomposition-products like kaolin. The computation of the analysis gives free quartz in the norm; this is probably due to decomposition and secondary silicification.

N.12. Loc.: Branch (E) of Oakey Creek. (Plate li., fig.1).

Handspecimen: this rock has a dark green base in which are studded gigantic idiomorphic prismatic felspar phenocrysts often attaining a length of more than an inch, and a diameter of over half-an-inch; and usually regularly octagonal in cross section. The rock forms sills at the head of the branches of Oakey Creek under Mount Odin.

Texture holocrystalline, coarsely porphyritic with a hypidiomorphic granular base.

Constituents: the huge felspar phenocrysts consist of acid labradorite and andesine, the extinction angle in symmetrical sections varying from 10° to 25°, but in most cases it is about 20°. The refractive index is greater than that of canada balsam. Twinning is on the Albite law, but pericline twinning is also met with. There are no other phenocrysts. The groundmass consists of a sanidine-like felspar which may be either orthoclase or anor-

thoclase. This occurs as microlites. Idiomorphic ægirine augite grains decomposing to chloritoid, apatite needles, greenish micaceous fibrous decomposition-products of the pinite group, finely divided magnetite, hæmatite, a little nepheline and cancrinite are also present.

Name: Labradorite Porphyry. Magmatic name, Andose (see Tables i. and ii.).

N.26. Loc.: Branch (C) of Oakey Creek.

Handspecimen a green, somewhat decomposed coarse-grained rock.

Texture holocrystalline, even-grained, hypidiomorphic-granular.

Composition: the main constituent is felspar in hypidiomorphic crystals which have been largely saussuritised, chloritised and kaolinised; it contains as inclusions magnetite, stout needles of apatite, and small idiomorphic grains of fluorite. The alteration of the rock has led to the production of a certain amount of secondary felspar in needles within the original phenocrysts. The original felspar was probably an albite surrounded by a zone of microperthite, decomposition having effected the exterior more than the interior. Representing what was originally augite and conforming to its crystalline outline, we have aggregates of chlorite and green chloritoid, sometimes serpentine as well. These occasionally contain a nucleus of uralite. Remarkable skeletons of ilmenite and magnetite are present in abundance. A little nepheline occurs, and decomposition-products after nepheline are fairly common. These include katapleiite, cancrinite, liebnerite pseudomorphs, etc. Rutile needles are very abundant. The other decomposition-products present are kaolin, chlorite, chloritoid, serpentine, hæmatite, saussurite, etc.

Name: Altered Augite-Nepheline-Syenite near Laurdalite.

N.14. Loc.: Branch (A) of Oakey Creek.

This rock occurs as a sill. In microscopic structure and mineral composition it closely resembles N.8 and N.9, and is therefore a sölvsbergite, or nordmarkite-porphyry.

Remarks.—The alkaline rocks dealt with so far are all derived from the sills underlying Mount Odin. Underlying the whole of

this mountain there is probably a large laccolitic mass, from different levels of which the sills are offshoots. All these rocks are undoubtedly differentiation-products of the one mass, presenting numerous features in common, chief of which are (1) the occurrence of nepheline and pseudomorphs after nepheline, (2) the occurrence sparingly of apatite phenocrysts of a greenish colour capped with pyramids at both ends and exhibiting a fine longitudinal striation, (3) the occurrence of soda-bearing pyroxene in the base.

The chemical analyses correspond excellently to the petrological compositions. Thus N.11, though the darker in colour, is much more acid than N.12, and contains much less of the iron oxides and lime. The dark colour of N.11 is due to the phenocrysts consisting of dark cloudy *microperthite* felspar, while the more basic phenocrysts of N.12 consist of white labradorite.

The alteration-products in these rocks are hard to determine. I have spent much time in trying to work out the exact nature of the fine micaceous pseudomorphs without avail. There is, however, no doubt that they sometimes approximate very closely to liebnerite and sometimes to geisikite, though usually analcite, calcite and zeolites occur with them. These minerals are secondary after nepheline and are associated with others such as cancrinite and katapleiite of similar origin. Sometimes the aggregates show definitely the outlines of the original nepheline crystals.

I have slides of nepheline tinguaite from the range between Spencer's Creek and the Snowy River (Guthrie Range), Mt. Kosciusko, which show exactly the same decomposition-products.

Associated with these minerals in the Nandewar nepheline rocks are certain chloritic, sericitic, and pinite alteration-products after ægirine-augite, felspar and soda-hornblende. This class of alteration-products resembles the other so closely that it has not been found possible to distinguish between them except where they form definitely pseudomorphs of regular outline.

All the alkaline rocks so far described contain an abundance of minerals which gelatinise with dilute HCl and stain with malachite-green.

The order of consolidation in these rocks usually was as follows: —

1. Magnetite : ilmenite ————————
2. Plagioclase ——————
3. Apatite ————————
4. Hornblende —————
5. Orthoclase ——————— — ———
6. Augite (Ægirine) —————
7. Nepheline ——————

N.25. Loc.: base of Ningadhun Rock.

Handspecimen white in colour with a few dark specks; light in weight, probably due to an abundance of minute vesicles; soft and friable like sandstone.

Texture holocrystalline; very fine-grained, microcrystalline; with trachytic fabric.

Composition: the main constituent is felspar, which forms about 90% of the rock; it occurs of both prismatic and tabular habits, the phenocrysts being chiefly sanidine of tabular habit, the remainder being partly sanidine and partly anorthoclase, the latter showing under the high power a delicate striation due to multiple twinning on various laws. Carlsbad and Baveno twinning are both common. Phenocrysts having an hourglass appearance between crossed nicols are probably Baveno fourlings. Next in order of abundance comes ægirine, which occurs both as corroded phenocrysts surrounded by decomposition and corrosion rims and as finer acicular crystals in the base. A deep blue hornblende (arfvedsonite or riebeckite) is represented fairly plentifully as minute highly pleochroic rods. Yellow and reddish iron ores and chlorite occur as decomposition-products. No nepheline or quartz is recognisable, but the rock stains slightly with malachite-green after gelatinisation with dilute acid.

Name: Trachytic Ægirine Trachyte. Magmatic name, Phlegrose.

Note on N.30: the specimen analysed from Ningadhun is a similar rock. It differs from N.25 only in that ægirine is relatively more abundant, riebeckite rather less so, occurring

only as occasional grains, and in the presence of a little interstitial quartz (*cp.* Tables i. and ii.).

N.31. Loc.: base of Ningadhun Rock.

Handspecimen: a dark porphyritic rock showing felspar phenocrysts in an aphanitic base. It was taken within a few feet of N.30 and N.25, but belongs to a totally different flow.

Texture apparently holocrystalline, the isotropic patches being referable to analcite and other decomposition-products; porphyritic, and with cryptocrystalline to microcrystalline pilotaxitic base which may be partly devitrified glass.

Composition: the phenocrysts are corroded and partially resorbed at the edges, and consist of andesine. A brownish-green hornblende has been present in the form of phenocrysts, but is now almost wholly replaced by chlorite, secondary magnetite and hæmatite. The groundmass consists of microlites of andesine, isotropic or almost isotropic decomposition-products and nepheline, a few stunted rods of a colourless pyroxene, acicular crystals of a yellow pyroxene which may be a relative of wöhlerite, magnetite and minute cubes of green spinel (pleonaste). A number of decomposition-products are present, amongst which the chief seem to be hæmatite, chlorite and dusty magnetite after hornblende and pyroxene; and sericite after felspar; also natrolite and opal infilling vesicles.

Name: Phonolitic Andesite.

N.49. Loc.: slopes of Mount Ningadhun. (Plate li., fig.3).

Handspecimen reddish-brown in colour, very hard, and aphanitic.

Texture apparently holocrystalline, microcrystalline to cryptocrystalline base, with phenocrysts; trachytic fabric.

Composition: the main constituents are microlites of orthoclase and albite, nepheline in corroded phenocrysts whose resorbed edges show alteration to cancrinite and geisikite, a highly pleochroic brown hornblende, probably cossyrite, with hæmatite and magnetite and sphene as decomposition-products, needles of a brown pyroxene not unlike wöhlerite, and glass. The rock is amygdaloidal, the infillings of the vesicles consisting of zeolites and opal.

Name: this rock is apparently a Cossyrite-Nepheline Trachy-Andesite, the high TiO_2 percentage shown in the analysis being confirmatory of the presence of cossyrite and wöhlerite. Magmatic name, Monzonose (*cp.* Tables i. and ii.).

Note: it is significant, in connection with the occurrence of quartz in the calculated norm, that the nepheline occurs as corroded phenocrysts, the base being andesitic. Further, the occurrence of opal shows that secondary silicification has taken place.

Both N.31 and N.49 are closely related chemically and mineralogically to the remarkable corundum basalt found at Billy King's Creek, south of Coonabarabran, in the Warrumbungles. They are all the basic differentiation-product of a magma exceedingly rich in Al_2O_3, Na_2O, and TiO_2, and very poor in MgO and FeO, just as the arfvedsonite trachytes (as N.25 and N.30) form the more acid differentiation-product.

The richness of the magma in TiO_2 is especially striking for the Nandewar Mountains. In many of the rocks where conditions have not been favourable for the formation of titaniferous amphiboles and pyroxenes, the titanic acid has crystallised out in the form of an abundance of sagenitic rutile needles.

N.20. Loc.: a hill west of Dingo Creek.

Handspecimen a dark greenish-brown rock, which occurs as a dyke in a hill near the doleritic laccolite at Dingo Creek. It contains numerous vesicles infilled with calcite. Under the microscope the main constituent is seen to be oligoclase-andesine showing Carlsbad and Albite twinning (R.I. greater than canada balsam, extinction angle 0°-10°). Hæmatite is fairly abundant through the decomposition of the original femic minerals. Opal and magnetite occur, and also some brownish, highly pleochroic aggregates and grains referable to katophorite and brownish needles referable to wöhlerite.

Name: Decomposed Phonolitic Andesite.

N.21. Loc.: dyke cutting dolerite laccolite, Dingo Creek.

Handspecimen a dark porphyritic rock with an aphanitic base. Texture hemihyaline and porphyritic.

Constituents: phenocrysts of orthoclase sanidine showing fine Carlsbad and Baveno twinning, sanidine microlites, iron ores and glass.

Name: Hemivitreous Porphyritic Trachyte.

Note: this rock is briefly described because it is important as one of the factors by means of which the relative ages of the calcic dolerite and the alkaline intrusives were determined.

Another dyke rock of the alkaline series cutting the doleritic mass is numbered N.48. It is wholly aphanitic, but microscopically porphyritic, having microlites of orthoclase sanidine, anorthoclase and oligoclase, and minute needles of greenish diopside in a noncrystalline base. Limonite occurs as a decomposition-product. This rock is a keratophyre.

N.15. Loc.: headwaters of Oakey Creek, branch of Bullawa Creek. (Plate l., fig.6; Plate li., fig.6).

Handspecimen an even-grained rock of a light grey colour, being made up of a whitish felspar and a greenish hornblende.

Texture holocrystalline, even-grained, with allotriomorphic granular fabric.

Constituents: the most abundant minerals by far are orthoclase and moirée microcline, both considerably kaolinised. Plagioclase with sericitic decomposition-products is fairly plentiful. Next in order of abundance is a greenish very pleochroic hornblende which is undergoing decomposition to magnetite and chlorite. Greenish ægirine-augite and colourless diopside are also present, as are also a few flakes of biotite with chloritic decomposition-products. A little quartz occurs interstitially. Albite is included in, and intergrown with, the orthoclase. The chief accessories are stout prisms of bluish apatite terminated with pyramids, titaniferous magnetite and ilmenite and fluorspar. Chlorite, serpentine, leucoxene and kaolin are the chief decomposition-products.

This rock, from the composition, is seen to have affinities with quartz syenite, quartz diorite, and the more alkaline augite syenites.

Name: Akerite. Magmatic name, Akerose (see Tables i. & ii.)

Note: this rock covers a great area towards the headwaters of Oakey Creek, a couple of miles above its junction with Bullawa Creek. It forms a large boss or laccolite which has been exposed by erosion. Chemically it is closely related to the dark syenite porphyries and labradorite porphyrites occurring as sills under Mount Odin.

N.32. Loc.: one-half mile W.N.W. of Ningadhun Rock.

Handspecimen a reddish, very vesicular rock, with large felspar phenocrysts. It was sectioned to determine whether it is a trachyte or andesite.

Texture holocrystalline, with phenocrysts up to 0·5 mm. long, and an extremely fine-grained microcrystalline base; fabric pilotaxitic in the base.

Constituents: andesine-labradorite felspar full of glass-inclusions, forming phenocrysts, and lath-shaped and tabular microlites of the same mineral; hæmatite replacing some hornblende; primary magnetite in minute idiomorphic grains; kaolin; a honey-yellow mineral, probably opal, and various other decomposition-products.

This rock is undoubtedly an altered andesite closely allied to the trachytes and phonolites which occur in the vicinity. Flows of these different differentiation-products occur frequently interbedded, one eruption giving a phonolitic lava, the next perhaps an andesite, the next a trachyte, and so on.

A porphyritic vesicular trachy-andesite of grey colour caps Ritter's Razorback between Bullawa Creek and Spring Creek. This rock in handspecimen seems intermediate between the andesite just described and the vesicular trachytes.

A pilotaxitic porphyritic andesite (N.33, Pl.li., fig.4) occurs around Deriah Mountain, which contains andesine-labradorite felspar; corroded, colourless diopside and light brown titaniferous augite; magnetite; ilmenite, and chlorite. This rock has also been shown to be later than the trachytes.

These andesitic rocks also form a link between the trachytes and the final basalts of the alkaline series. The first generation is felspar, usually a labradorite in highly corroded phenocrysts, round which a zone of orthoclase has frequently developed. The second generation of felspar consists of orthoclase and albite.

N.43. Loc.: at the coal seam near the basic laccolite, Dingo Creek.

Handspecimen a reddish porphyritic vesicular rock, which forms a sill a few yards thick.

Texture holocrystalline, porphyritic, with a moderately even-grained vesicular base showing flow-structure and typical trachytic fabric.

Composition: the phenocrysts are tabular and somewhat corroded, and show Carlsbad and Baveno twinning; they consist of orthoclase, and are interpenetrated with acicular microlites of another felspar, apparently albite. The base consists of acicular anorthoclase microlites, rods of hæmatite distinctly secondary after ægirine and blue amphibole; a little unchanged riebeckite and ægirine; and some primary hæmatite. A few fragments of quartz appear interstitially, and zircon occurs both as inclusions in the phenocrysts and as a constituent of the base. Nepheline does not appear to be present. Magnetite occurs in small amount.

Name: Sölvsbergite.

N.44 is a similar rock which comes from another similar sill on Dingo Creek. The felspar of this rock contains curious wavy bands and circles of another mineral, apparently quartz, intergrown with it. Both quartz and nepheline occur very sparingly in the base.

N.46 is another somewhat similar rock from a columnar mass a couple of miles N.W. of Ningadhun. This rock is also holocrystalline, and has a camptonitic fabric. The constituents are sanidine (perhaps anorthoclase), ægirine, primary hæmatite and riebeckite (or arfvedsonite). The mass is probably laccolitic.

The three rocks last-mentioned are typical of the great bulk of the trachyte of the Nandewars, and should perhaps be classed as sölvsbergites. Many of the really volcanic rocks of the flows are similar in structure and composition. The fresh rock has a flesh-colour due to primary hæmatite; on decomposition the colour changes to brick-red.

Similar rocks were met with over considerable areas at the head of Bobbiwaa Creek. Thus N.55 occurring near the base of Dripping Rock is a highly vesicular, holocrystalline, porphyritic red trachyte with trachytic fabric in the base. The constituents are felspar, probably anorthoclase, forming phenocrysts and microlites; katophorite (?), a brown highly pleochroic hornblende showing brown, red and deep blue or purple tints; ægirine; primary and secondary hæmatite, quartz; magnetite and opal.

Another specimen from this locality contains, in addition, a little tridymite, fluorite, and nepheline. After gelatinising with acid, the interstitial matter stains strongly. A little quartz is also apparently present and also cancrinite. These colourless minerals commonly contain as inclusions sagenitic rutile needles, zircon ægirite and tabular microlites of a brownish mineral.

The brown amphibole of this rock when fresh exhibits very strong pleochroism in very thin slices, but where the sections are thick the pleochroism tints are masked by a deep colour. The double refraction is likewise masked, and the mineral shows no position of extinction. In outline the mineral has the shape characteristic of arfvedsonite. It is therefore probably a katophorite. A little brownish wöhlerite (?) occurs sparingly in the rock.

All the rocks which contain the brown pleochroic mineral contain also distinct hæmatite having the same crystalline form and apparently pseudomorphic after it, not by decomposition but by alteration by pneumatolysis in the period of consolidation of the rock. Brownish minerals which are neither the one nor the other of these but conform to the same habit (either prismatic or in dendritic aggregates) also occur. These may, and probably do, belong to the allied mineral species of (1) mosandrite, rinkite and johnstrupite, and (2) wöhlerite, which are all zirconium-bearing minerals, and therefore show bluish pleochroism tints in some positions in thin sections. Those crystals which show both green and blue as well as red-brown are probably true katophorite.

N.59. Loc.: Deriah Mountain. (Plate li., fig.2).

Handspecimen indistinguishable from the trachyte of Mount Ngun-Ngun in the Glass House Mountains. It is a medium-

grained, greenish-grey rock, which becomes red on weathering. It forms the whole plug of Deriah Mountain.

Texture holocrystalline, medium-grained and even grained, with trachytic habit.

Composition: the main constituents are anorthoclase felspar and sanidine. In addition we have ægirine in broken fragments of idiomorphic crystals; arfvedsonite in the characteristic aggregates; a little brown pleochroic amphibole intergrown with arfvedsonite; hæmatite, and very sparingly quartz.

Name: Arfvedsonite Ægirine Trachyte. Magmatic name, Phlegrose (*cp.* Tables i. and ii.).

N.53. Loc.: around Deriah Mountain.

Handspecimen a highly porphyritic and vesicular rock. The vesicles contain numerous decomposition-products of a zeolitic nature.

Texture holocrystalline, porphyritic, with a hyalopilitic base which is partly cryptocrystalline.

Composition: the phenocrysts consist mainly of labradorite felspar of the composition Ab_2An_3; they are idiomorphic and of prismatic habit, and are twinned on the Carlsbad, Albite and Pericline laws. Amongst the phenocrysts must also be included some very corroded phenocrysts of albite, oligoclase and orthoclase which are studded with inclusions of glass and apatite. Those of albite and oligoclase are intergrown with orthoclase at the centre. Felspar forms also the main bulk of the base, in the form of microlites of acicular habit; these needles possess straight extinction and have a refractive index lower than canada balsam; they are for the most part untwinned, but in rare cases they possess Carlsbad twinning; they may be either orthoclase or albite. Interstitially we have a brownish material which, under the high power, is partly resolved into minute round globules. The rest of the brownish material consists of glass and iron ores including some idiomorphic magnetite grains, secondary hæmatite and limonite.

Name: this rock must be referred to the trachyte family, though from the excess of plagioclase in it, it furnishes a link

between the trachytes and the andesites of the locality. It is a Porphyritic-Hypocrystalline Plagioclase Trachyte.

N.51. Loc.: Dingo Creek near basic laccolite. (Plate l., fig.5).

Handspecimen white in colour, the rock occurring as a sill. It is composed almost wholly of felspar, which is of two generations, and forms more than 99 % of the bulk.

Texture holocrystalline, with phaneric phenocrysts and an aphanitic trachytic base.

Composition: the phenocrysts are clear like sanidine, but the cleavage and extinction angle (8°-10°) show that they belong to the species anorthoclase; they are twinned chiefly on the Carlsbad plan, but occasionally an albite twin is seen; some crystals show also microscopic polysynthetic twinning. Occasionally an acicular sanidine crystal is seen enveloped by a crystal of albite. Often again two sanidine laths are twinned so as to form a cross-like staurolite, each of the two individuals being itself twinned on the Carlsbad law. These are probably Baveno interpenetration twins composed of two individual Carlsbad twins. The other constituents, which occur only in minute quantity, comprise (1) interstitial rods of lemon-yellow to greenish ægirine-augite, (2) a few flakes of hæmatite, (3) occasionally a fragment of riebeckite, and (4) a few fragments of quartz.

Name: a typical Bostonite, or Sanidine-Anorthoclase Trachyte-Porphyry (*cp.* Bostonite from the Lake Champlain District, U.S.A., Kemp & Marsters, Bull. 107, Geol. Surv. U.S.A.).

N.23. Loc.: Kangaroo Valley near Ningadhun. (Plate li., fig.5).

Handspecimen a dark basaltic rock containing huge plagioclase phenocrysts.

Texture holocrystalline, uneven-grained; fabric porphyritic, with microcrystalline hypidiomorphic-granular base.

Composition: the main constituents are felspar, augite, olivine, and magnetite. The felspar phenocrysts consist of basic labradorite; they are highly corroded, and contain magnetite and apatite inclusions. The olivine is likewise very corroded, and shows also partial decomposition to serpentine. The augite occurs as small idiomorphic grains in the base; it is a colourless

or very pale greenish variety (salite). The felspar of the base is essentially albite. The base contains no olivine or basic felspar, and it consists essentially of albite, augite, magnetite, and a little apatite.

This rock is formed either by a mixture of reliquefied basic rock with alkaline lava, or by the extrusion of the last basic residuum of an alkaline magma. It is typical of a large number of varieties of very felspathic and almost olivine-free basalt and augite andesite, which occur capping the older trachytes and phonolites south of Eulah Creek. The basalt from the Sandilands Ranges, New England, is very like this rock in section and handspecimen.

I have tried in the foregoing notes to give the main features of all the rock-varieties met with in the Nandewars, rather than tedious detailed petrological descriptions of a few types, with the special object in view of inviting comparison.

All these rocks have certain features in common, from the most acid to the most basic; most striking correspondence is exhibited in

(1) The predominance of felspars rich in soda.

(2) The abundance of zirconium and titanium minerals, such as arfvedsonite, katophorite and zircon in the trachytes; wöhlerite (?), ilmenite, cossyrite (?), etc., in the phonolites; rutile and sphene in the more basic rocks.

(3) The rarity of magnesian minerals, such as olivine, even in the most basic rocks.

(4) The prevailing tendency in all to very marked porphyritic structure, and in very many to vesicular structure, even amongst sill rocks; the porphyritic structure points to a period of cooling in a deep-seated reservoir during which the minerals of the first generation formed; the vesicular structure suggests that masses of water or water-vapour (charged with mineralisers as shown by the rare minerals) gained access to the cooling mass and gave it renewed mobility, enabling it to force its way along all weak points between sedimentary beds to form sills, and to force openings to the surface, whence it flowed as lava streams.

TABLE I.—CHEMICAL ANALYSES OF ROCKS FROM THE NANDEWAR MOUNTAINS.

	N.30. Trachyte. Loc.: Mt. Ningadhun.		N.59A. Trachyte. Loc.: Deriah Mtn.		N.55. Trachyte. Loc.: nr. Dripping Rock.		N.11. Pulaskite Porphyry. Loc.: Branch of Oakey Ck. nr. Mt. Odin.		N.10. Phonolite. Loc.: Oakey Creek.		N.49. Phonolitic Trachyte. Loc.: Mt Ningadhun.	
	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.
SiO_2	64·63	1·077	64·31	1·072	64·38	1·073	58·90	0·982	61·27	1·021	51·98	0·866
Al_2O_3	16·55	0·163	15·05	0·147	17·13	0·167	16·48	0·162	16·00	0·157	22·46	0·221
Fe_2O_3	2·93	0·018	3·39	0·021	5·62	0·035	2·98	0·019	2·59	0·016	2·48	0·016
FeO	1·16	0·017	2·33	0·032	0·28	0·004	3·35	0·046	4·04	0·056	1·87	0·026
MnO	0·08	0·001	0·09		—		0·08		0·10		0·08	
NiO	trace.		0·03	0·001	—		0·05	0·002	trace	0·001	0·04	0·002
CoO	abs.		p.n.d.		—		—		abs.		p.n.d.	
MgO	0·16	0·004	0·14	0·003	0·03	0·001	0·78	0·019	0·39	0·010	0·83	0·021
CaO	0·46	0·009	1·54	0·027	0·61	0·011	2·78	0·050	1·93	0·034	4·63	0·082
Na_2O	5·23	0·084	4·77	0·077	4·59	0·074	4·09	0·066	4·25	0·068	3·66	0·060
K_2O	6·11	0·065	6·59	0·070	6·49	0·069	6·05	0·064	6·31	0·067	3·93	0·041
H_2O (110°C –) ...	1·05	0·133	0·79	0·083	loss on	0·089	0·82	0·067	0·64	0·056	1·08	0·172
H_2O (110°C +) ...	1·35		0·39		ignition		0·34		0·36		2·06	
CO_2	trace		abs.		1·63		1·50	0·034	0·16		0·04	
TiO_2	0·58	0·008	1·25	0·015	0·56	0·008	1·47	0·019	1·02	0·013	4·71	0·059
ZrO_2	0·07	0·001	0·09	0·001	—		—		—		—	
P_2O_5	abs.		abs.		—		p.n.d.		p.n.d.		—	
SO_3	abs.		abs.		—		—		—		—	
Cl	trace		0·02	0·001	—		—		—		—	
F	—		0·10	0·005	—		—		—		—	
$S(FeS_2)$	trace*		abs.*		—*		—*		—*		—*	
BaO	abs.		abs.		abs.		abs.		abs.		abs.	
SrO	abs.		abs.		abs.		abs.		abs.		abs.	
Li_2O	abs.		abs.		abs.		abs.		abs.		abs.	
Sum	100·36		†100·98		101·32		99·67		99·06		99·85	

† Less oxygen equivalent of F 0·05=100·93. * No pyrites detected in the slide.

TABLE I.—CHEMICAL ANALYSES OF ROCKS FROM THE NANDEWAR MOUNTAINS *(continued)*.

	N.12. Labradorite Porphyry. Loc.: Branch of Oakey Ck. nr. Mt. Odin.		N.17. Dolerite. Loc.: Laccolite, Dingo Creek.		N.18. Monchiquite Lamprophyre. Loc.: Sill, Dingo Ck.		N.15. Akerite. Loc.: Head of Oakey Ck. & Bullawa Ck.		N.62. Perlitic Pitchstone. Loc.: nr. Boggabri.	
	%	Mol.	%	Mol.	%	Mol.	%	Mol.	%	Mol.
SiO_2	51·30	0·855	47·20	0·787	36·88	0·615	56·63	0·944	66·68	1·111
Al_2O_3	16·13	0·158	11·78	0·116	4·53	0·044	17·71	0·174	13·39	0·131
Fe_2O_3	3·01	0·019	1·94	0·012	2·03	0·013	3·61	0·023	0·91	0·006
FeO	6·92	0·096	9·04	0·125	9·67	0·135	4·64	0·064	0·21	0·008
MnO	0·19	0·003	0·26	0·004	0·04	0·002	0·03		—	
NiO	0·05		0·03		0·07		abs.		—	
CoO	p.n.d		abs.		abs.		abs.		—	
MgO	2·58	0·065	9·95	0·249	25·40	0·635	1·47	0·037	abs.	—
CaO	6·97	0·125	11·63	0·207	7·61	0·136	4·06	0·072	2·72	0·048
Na_2O	4·00	0·066	1·61	0·026	1·17	0·019	5·11	0·082	2·23	0·035
K_2O	2·07	0·022	1·67	0·018	0·43	0·004	3·65	0·038	2·51	0·027
H_2O (110°C –)	0·50	0·133	0·28	0·083	0·58	0·078	0·49	0·067	loss on ignition 10·05 CO_2 being a mere trace	0·560
H_2O (110°C +)	1·89		1·24		0·82		0·70			
CO_2	1·64	0·036	0·17	0·003	8·10	0·184	0·01			
TiO_2	2·78	0·035	4·31	0·054	2·10	0·026	2·00	0·025	0·38	0·005
ZrO_2	—		—		0·06	0·001	0·06	0·001	—	
P_2O_5	p.n.d.		p.n.d.		abs.		p.n.d.		—	
SO_3	trace		—		—		—		—	
Cl	—		—		—		—		—	
F	—		—		—		—		—	
$S(FeS_2)$	—*		—*		0·17	0·006	—*		—*	
BaO	abs.		abs.		abs.		abs.		—	
SrO	trace		abs.		abs.		abs.		—	
Li_2O	abs.		abs.		abs.					
Sum	100·03		101·11		†99·66		100·17		99·08	

† Less 0·08 oxygen equivalent of S = 99·58.

* No pyrites detected in the slide.

N.30. Arfvedsonite Trachyte. Loc.: Mt. Ningadhun.	Per cent.	N.59A. Arfvedsonite Trachyte. Loc.: Mt. Deriah.	Per cent.	N.55. Hæmatite Trachyte. Loc.: Dripping Rock.	Per cent.	N.11. Pulaskite Porphyry. Loc.: Mt. Odin, Oakey Ck.	Per cent.	N.10. Phonolitic Trachyte. Loc.: Oakey Creek.	Per cent.
Quartz	9·48	Quartz	9·84	Quartz	11·70	Quartz	8·46	Quartz	7·26
Orthoclase ...	36·14	Orthoclase ...	38·92	Orthoclase ..	38·36	Orthoclase ...	35·58	Orthoclase ...	37·25
Albite	44·02	Albite	40·35	Albite	38·78	Albite	34·58	Albite	35·63
Anorthite ...	2·50	Zircon	0·18	Anorthite ...	1·95	Anorthite ...	4·45	Anorthite ...	6·12
Corundum ...	5·50	Diopside ...	0·90	Corundum ...	1·84	Corundum ...	1·63	Diopside	1·89
Zircon	0·18	Wollastonite ...	2·09	Hypersthene ...	0·10	Hypersthene ..	3·22	Hypersthene ...	3·70
Magnetite ...	2·32	Magnetite ...	3·94	Hæmatite ...	5·70	Magnetite ...	4·41	Magnetite ...	3·71
Ilmenite	1·06	Hæmatite ...	0·64	Ilmenite ...	0·46	Ilmenite	2·89	Ilmenite	1·98
Hæmatite ...	1·28	Ilmenite	2·28	Titanite	0·78	Calcite	3·40	Calcite	0·40
Hypersthene ...	0·53	Water	1·18	Water	1·63	Water	1·16	Water	1·00
Water	2·40								
Sum	100·43	Sum	100·32	Sum	101·30	Sum	99·78	Sum	98·94
$\frac{\text{Sal.}}{\text{Fem.}}=\frac{92\cdot83}{5\cdot20}>\frac{7}{1}$ Class I. (Persalane).		$\frac{\text{Sal.}}{\text{Fem.}}=\frac{89\cdot29}{9\cdot35}>\frac{7}{1}$ Class i.		$\frac{\text{Sal.}}{\text{Fem.}}=\frac{92\cdot63}{7\cdot04}>\frac{7}{1}$ Class i.		$\frac{\text{Sal.}}{\text{Fem.}}=\frac{84\cdot71}{10\cdot52}>\frac{7}{1}$ Class i.		$\frac{\text{Sal.}}{\text{Fem.}}=\frac{86\cdot25}{11\cdot28}>\frac{7}{1}$ Class i.	
$\frac{Q}{F}=\frac{9\cdot48}{82\cdot66}<\frac{1}{7}$ Order 5. Canadare.		$\frac{Q}{F}=\frac{9\cdot84}{79\cdot28}<\frac{1}{7}$ Order 5.		$\frac{Q}{F}=\frac{11\cdot70}{79\cdot09}<\frac{3}{5}>\frac{1}{7}$ Order 4.		$\frac{Q}{F}=\frac{8\cdot46}{74\cdot62}<\frac{1}{7}$ Order 5.		$\frac{Q}{F}=\frac{7\cdot26}{79\cdot00}<\frac{1}{7}$ Order 5.	
$\frac{Na_2O+K_2O}{CaO}=\frac{149}{9}>\frac{7}{1}$ Rang 1 (Peralkalic) Nordmarkase.		$\frac{Na_2O+K_2O}{CaO}=\frac{147}{0}>\frac{7}{1}$ Rang 1.		$\frac{Na_2O+K_2O}{CaO}=\frac{143}{7}>\frac{7}{1}$ Rang 1.		$\frac{Na_2O+K_2O}{CaO}=\frac{130}{16}>\frac{7}{1}$ Rang 1.		$\frac{Na_2O+K_2O}{CaO}=\frac{135}{22}<\frac{7}{1}>\frac{5}{3}$ Rang 2.	
$\frac{K_2O}{Na_2O}=\frac{65}{84}<\frac{5}{3}>\frac{3}{5}$ Subrang 3 (Sodipotassic).		$\frac{K_2O}{Na_2O}=\frac{70}{77}<\frac{5}{3}>\frac{3}{5}$ Subrang 3 (Sodipotassic).		$\frac{K_2O}{Na_2O}=\frac{69}{74}<\frac{5}{3}>\frac{3}{5}$ Subrang 3.		$\frac{K_2O}{Na_2O}=\frac{64}{66}<\frac{5}{3}>\frac{3}{5}$ Subrang 3.		$\frac{K_2O}{Na_2O}=\frac{67}{68}<\frac{5}{3}>\frac{3}{5}$ Subrang 3.	
Magmatic name: Phlegrose,		Magmatic name: Phlegrose.		Magmatic name: Liparose.		Magmatic name: Phlegrose.		Magmatic name: Pulaskose	

TABLE II.—CONTINUED.

N. 49.
Altered Phonolitic Trachyte
Loc.: Mt. Ningadhun.

	Per cent.
Quartz	6·36
Orthoclase ...	22·80
Albite	31·44
Anorthite ...	13·62
Corundum ...	7·24
Hypersthene ...	2·36
Hæmatite ...	2·56
Titanite	6·47
Ilmenite	3·95
Water	3·14
Sum	99·94

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{81 \cdot 46}{15 \cdot 34} < \frac{7}{1} > \frac{5}{3}$$
Class ii.

$$\frac{Q}{F} = \frac{6 \cdot 36}{67 \cdot 86} < \frac{1}{7}$$
Order 5.

$$\frac{Na_2O + K_2O}{CaO} = \frac{101}{49} < \frac{7}{1} > \frac{5}{3}$$
Rang 2.

$$\frac{K_2O}{Na_2O} = \frac{41}{60} < \frac{5}{3} > \frac{3}{5}$$
Subrang 3.

Magmatic name: Monzonose.

N. 12.
Labradorite Porphyry.
Loc.: Mt. Odin, Oakey Ck.

	Per cent.
Quartz	3·54
Orthoclase ...	12·23
Albite	34·58
Anorthite ..	19·46
Diopside	4·08
Hypersthene ...	10·45
Magnetite ...	4·41
Ilmenite	5·17
Calcite	3·70
Water	2·39
Sum	100·01

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{69 \cdot 81}{24 \cdot 11} < \frac{7}{1} > \frac{5}{3}$$
Class ii.

$$\frac{Q}{F} = \frac{3 \cdot 54}{66 \cdot 27} < \frac{1}{7}$$
Order 5.

$$\frac{K_2O + Na_2O}{CaO} = \frac{88}{70} < \frac{5}{3} > \frac{3}{5}$$
Rang 3.

$$\frac{K_2O}{Na_2O} = \frac{22}{66} < \frac{3}{5} > \frac{1}{7}$$
Subrang 4.

Magmatic name: Andose.

N. 17.
Dolerite.
Loc.: Dingo Creek.

	Per cent.
Orthoclase ...	11·68
Albite	13·62
Anorthite ...	19·18
Diopside	29·42
Hypersthene ...	1·73
Olivine	12·46
Magnetite ...	2·78
Ilmenite	8·06
Calcite	0·30
Water	1·52
Sum	100·75

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{44 \cdot 48}{54 \cdot 45}$$
Class iii.

$$\frac{Q}{F} = \frac{0}{44 \cdot 48} < \frac{1}{7}$$
Order 5.

$$\frac{K_2O + Na_2O}{CaO} = \frac{47}{69} < \frac{5}{3} > \frac{3}{5}$$
Rang 3.

$$\frac{K_2O}{Na_2O} = \frac{21}{26}$$
Subrang 3.

Magmatic name: Kentallenose.

N. 18.
Monchiquite
Lamprophyre.
Loc.: Dingo Creek.

	Per cent.
Orthoclase ...	2·22
Albite	9·96
Anorthite ...	5·84
Calcite	11·50
Magnetite ...	5·88
Olivine	33·96
Hypersthene ...	21·86
Ilmenite	3·95
Magnetite ...	3·02
Water	1·40
Sum	99·59

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{18 \cdot 02}{62 \cdot 79}$$
Class iv.

$$\frac{\text{Pyrox.} + \text{Oliv.}}{\text{Mag.}} = \frac{55 \cdot 82}{6 \cdot 97} > \frac{7}{1}$$
Order 1.

$$\frac{P}{O} = \frac{21 \cdot 86}{33 \cdot 96} < \frac{5}{3} > \frac{3}{5}$$
Section iii.

$$\frac{MgO + FeO}{CaO} = \frac{770}{136} < \frac{7}{1} > \frac{5}{3}$$

$$\frac{MgO}{FeO} = \frac{635}{135} < \frac{1}{7} > \frac{5}{3}$$
Subrang 2.

Magmatic name: Rossweinose.

N. 15.
Akerite.
Loc.: Oakey Creek.

	Per cent.
Quartz	2·76
Orthoclase ...	21·13
Albite	42·97
Anorthite ...	15·01
Diopside	3·56
Hypersthene ...	3·95
Magnetite ...	5·34
Ilmenite	3·80
Water	1·19
Sum	99·71

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{81 \cdot 87}{16 \cdot 65} < \frac{7}{1} > \frac{5}{3}$$
Class ii.

$$\frac{Q}{F} = \frac{2 \cdot 76}{79 \cdot 11} < \frac{1}{7}$$
Order 5.

$$\frac{Na_2O + K_2O}{CaO} = \frac{120}{54} < \frac{7}{1} > \frac{5}{3}$$
Rang 2.

$$\frac{K_2O}{Na_2O} = \frac{38}{82} < \frac{3}{5} > \frac{1}{7}$$
Subrang 4.

Magmatic name: Akerose.

N. 62.
Perlitic Pitchstone.
Loc.: nr. Boggabri.

	Per cent
Quartz	37·44
Orthoclase ...	15·01
Albite	18·34
Anorthite ...	13·07
Hæmatite ...	0·96
Titanite	0·20
Ilmenite	0·46
Corundum ...	2·24
Water	10·05
Sum	97·77

$$\frac{\text{Sal.}}{\text{Fem.}} = \frac{86 \cdot 10}{1 \cdot 62} > \frac{7}{1}$$
Class i.

$$\frac{Q}{F} = \frac{37 \cdot 44}{46 \cdot 42} < \frac{5}{3} > \frac{3}{5}$$
Order 3.

$$\frac{Na_2O + K_2O}{CaO} = \frac{62}{47} < \frac{5}{3} > \frac{3}{5}$$
Rang 3.

$$\frac{K_2O}{Na_2O} = \frac{27}{85}$$
Subrang 3.

Magmatic name: Riesenose.

Discussion of the Analyses.

The chemical examination of the Nandewar rocks was conducted in the Chemical Department, Sydney University, and I am indebted to Professor Liversidge and Mr. Schofield for having placed apparatus at my disposal.

The alkaline rocks analysed all belong to the intermediate group. Yet there are both acidic and basic alkaline rocks in the district which were not analysed, having been satisfactorily determined microscopically.

Three of the rocks analysed, namely, dolerite from Dingo Creek (N.17), lamprophyre, Dingo Creek (N.18), and perlitic pitchstone, Boggabri (N.62), exhibit no definite relationship with the alkaline series.

The lamprophyric rock probably has a monchiquitic base. Felspar is very rare; most of the Al_2O_3 exists in the spinel (pleonaste). The alkali not having sufficient Al_2O_3 to form felspar, has gone to form analcite. This rock might indeed be best regarded as the result of a kind of magmatic mixture in which an alkaline magma has burst through a very basic mass, and carried along in it fragments of peridotite (xenoliths) and xenocrysts of spinel and hypersthene. The occurrence is strictly analogous to that which has been described by Mr. C. Süssmilch, F.G.S., for the Bombo Quarries near Kiama.*

In both instances, too, we have an alkaline rock (at Kiama, an orthoclase basalt†) carrying these basic xenoliths. Mr. C. Süssmilch has kindly shown me his specimens, and the resemblance to mine is very striking. A similar occurrence has been described at the Pennant Hills Quarry.‡

The chemical analysis of the Boggabri pitchstone gives no clue as to whether this rock is of the same age as the trachytes or not, a matter for which I had insufficient field-evidence to decide.

* "On the Occurrence of Inclusions of Basic Plutonic Rocks in a Dyke near Kiama." Journ. Proc. Roy. Soc. N. S. Wales, Vol. xxxix.

† "Geology of the Kiama-Jamberoo Districts." Rec. Geol. Surv. N. Wales, Vol. viii.

‡ Journ. Proc. Roy. Soc. N. S. Wales, 1893.

All the other analyses are of alkaline rocks. The trachytes from Ningadhun (N.30), Deriah Mountain (N.59), and Dripping Rock (N.55) are very similar in chemical composition, and are also closely allied to the arfvedsonite trachytes of the Warrumbungles, to my analyses of which attention is directed. They all lie on the borderlines between the subrangs of Phlegrose, Nordmarkose, and pulaskose of the quantitative classification.

The dark sill rocks N.11 (Pulaskite Porphyry), N.10 (Phonolitic Trachyte), and N.12 (Labradorite Porphyry) are of considerable interest. The specimens analysed containing no calcite, the CO_2 present is contained in the secondary minerals pseudomorphic after nepheline, namely hydronephelite, liebnerite and geisekite. The Pulaskite Porphyry is in handspecimen almost as dark as a basalt (dark green), and would not be judged to be of very nearly the same composition as the light-coloured trachytes. Microscopic examination, however, reveals that the felspar is essentially anorthoclase and microcline microperthite, and that ferromagnesian minerals are not abundant. The chemical analysis makes the position of the rock still more certain, and the norm fixes its magmatic name as phlegrose, the same as the arfvedsonite trachytes.

The analysis of N.15 shows that this rock chemically as well as structurally is akerite.

The altered nepheline phonolite, N.49, was analysed because it contained the same doubtful minerals as the corundum-basalt from Billy King's Creek (W.40) in the Warrumbungle Mountains. The analysis suggests that their determination as corundum and laavenite is correct. In the quantitative system this rock has the magmatic name monzonose, and contains quartz in the norm, which differs in a remarkable way from the mode.

Determination of P_2O_5.—This constituent was not determined in any of the rocks analysed from the Warrumbungle and Nandewar Mountains, as it was found that utterly unreliable results were obtained. The amount of P_2O_5 in all these rocks would be very small, in those where apatite is most abundant, such as the dolerite (N.17) and the akerite (N.15) reaching a maximum

of perhaps 0·50 %, whilst in the trachytes it would be practically absent. By taking 0·0025 gram of microcosmic salt containing about 0·0005 gram of P_2O_5, precipitating in the usual way with ammonium molybdate, redissolving the precipitate and precipitating as magnesium phosphate, a precipitate weighing 0·0050 gram was obtained, equivalent to 0·0030 gram of P_2O_5.

This I attribute to the following cause, viz., the ammoniacal solution containing the magnesium phosphate in standing 24 hours takes up the carbon dioxide from the air and silica from the glass vessel, with the result that one weighs basic magnesium silicate and carbonate with the phosphate. Error from this cause can only be avoided by letting the solution stand in a platinum vessel in a carbon-dioxide-free atmosphere.

It was also noticed that, in following Washington's method of decomposing the rock with nitric and hydrofluoric acid, in the part used for determining P_2O_5, no precipitate was obtained with P_2O_5 without warming, although the rocks might contain apatite equivalent to between 0·05 and 0·25 % of P_2O_5; further, on warming, too much molybdate precipitate is generally obtained. These irregularities are *probably* due to the presence of traces of HF, which hinder the formation of the phosphomolybdate; and, on warming, to the formation of a certain amount of silicomolybdate; but the matter needs looking into.

In the face of these difficulties and as P_2O_5 was an unimportant constituent in the rocks which I was examining, I did not consider it worth my while to devise a method for overcoming the difficulties. It is very possible that inexperienced analysts often follow the text-book methods without enquiring into their accuracy; and, not observing the many precautions necessary, get high results for P_2O_5. The amount of this constituent given in many analyses of trachyte, phonolite and granite seems absurdly high. The smaller the actual quantity of P_2O_5 in a rock, the more exaggerated the error becomes.

As accuracy in rock-analysis is daily becoming more important, it would be well if some chemist could take up the matter of devising a good laboratory method for determining P_2O_5.

The Differentiation of the Nandewar Rocks.

A glance at the analyses will serve to show that in the alkaline rocks there is a gradation both mineralogically and chemically. If any one of them can be considered to represent the parent-magma, it must be the pulaskite porphyry, N.11.

	Trachyte N.30. Ningadhun.	Labradorite Porphyry, N.12.	Mean of N.30 and N.12.	Pulaskite Porphyry, N.11.
SiO_2 ...	64·63	51·30	57·97	58·90
Al_2O_3 ...	16·55	16·13	16·34	16·48
Fe oxides..	4·09	9·93	7·01	6·33
MgO ...	0·16	2·58	1·37	0·78
CaO ...	0·46	6·97	3·71	2·78
Na_2O ...	5·23	4·00	4·61	4·09
K_2O ...	6·11	2·07	4·09	6·05
TiO_2 ...	0·58	2·78	1·68	1·47

The phonolites (represented by N.10, analysed) have almost the same composition as the pulaskite-porphyry. The akerite is a special differentiation-product, the complementary type of which I have not met with. It is nevertheless not far removed from the mean of N.30 (trachyte) and N.12 (labradorite porphyry) given in the above table. In fact it will be easily observed that if that mean be regarded as the composition of the parent-magma (Haupt-magma) the akerite and pulaskite porphyry are complementary forms on either side of it.

	Akerite.	Pulaskite Porph.	Mean.	Haupt-Magma.
SiO_2 ...	56·63	58·90	57·76	57·97
Al_2O_3 ...	17·71	16·48	17·09	16·34
Fe oxides..	10·25	6·33	8·29	7·06
MgO ..	1·47	0·78	1·12	1·37
CaO ...	4·06	2·78	3·41	3·73
Na_2O ..	5·11	4·09	4·60	4·61
K_2O ...	3·65	6·05	4·85	4·09
TiO_2 ..	2·00	1·47	1·73	1·68

The pulaskite-porphyry is also interesting as being in chemical composition very near to the trachy-andesites (monzonose) of the

Warrumbungle Mountains, to grey laurvikite from Laurvik (Norway), to umptekite, Red Hill (New Hampshire), and to rhombenporphyr, as the following table shows.

Monzonose, W.1, Warrumbungles.		Pulaskite Porphyry, N.11.	Laurvikite, Laurvik.	Umptekite, Red Hill.	Rhomben-porphyr, Norway.
SiO_2 ...	58·95	58·90	58·88	59·01	58·54
Al_2O_3 ...	17·80	16·48	20·30	18·18	17·28
Fe oxides...	7·46	6·33	6·22	5·28	8·61
MgO ...	0·57	0·78	0·79	1·05	1·81
CaO ...	2·49	2·78	3·03	2·40	3·04
Na_2O ...	4·51	4·09	5·73	7·03	7·18
K_2O ...	6·39	6·05	4·50	5·34	3·24
TiO_2 ...	0·76	1·47	det. with Al_2O_3	0·81	—

The rock under discussion differs from laurvikite in containing less lime and alumina; it contains relatively less alkali than umptekite, and less silica than typical pulaskite. It is best considered to be a basic facies of pulaskite. *What is particularly striking is that it appears that the parent-magma of the Nandewar alkaline rocks is the same as that of the Warrumbungle rocks.*

The Quantitative Classification of Igneous Rocks.

Of late years there has been a good deal of discussion as to the merits of the quantitative classification and magmatic nomenclature devised by Iddings, Washington, Pirsson and Cross. A few remarks on this subject will not be out of place here.

The quantitative system has done excellent work in waking up petrologists to the value of rock-analysis. Analyses of rock-types and of rocks difficult to classify are essential both for correct identification and for arriving at conclusions regarding magmatic differentiation. Further, for purposes of comparison, the calculation of the norm is invaluable. Take, for instance, the analyses of N.30 and N.11 in Table i. The microscope revealed affinities between these rocks, sufficiently to enable one to say that both belong to the alkaline group. The analysis brings their affinity into more marked prominence. But it is only when we compare

their calculated norms that we see how closely allied they are. The calculation of the norm in terms of standard minerals is a great boon for purposes of comparison, and having the analysis we can also calculate it in terms of other mineral-combinations, and thereby ascertain what other rock-species might arise from the same magma.

As for the classification based on the norms, it must be said that it is no better than previous classifications. Whether we call a certain rock syenite-porphyry, phlegrose, or nordmarkite, we must first know the chemical and mineralogical composition corresponding to these names; and the Rosenbusch and Brögger names have the advantage over the magmatic names that they define the mineralogical composition much more accurately, and give us some idea of texture, fabric and facies as well.

As Professor Marshall* of Dunedin and many others have shown, the quantitative system brings together, under a common name, rocks which are widely different, and separates closely allied ones.

This is strikingly exemplified in my studies on the petrology of the Warrumbungle and Nandewar Mountains. Thus the labradorite porphyry (N.12) is seen from field-evidence and microscopic examination to be a differentiation-product of a pulaskite magma. There are many analogies in the mode of occurrence and the composition and structure of the groundmass to bind it to the alkaline series. Yet the fact that it is chemically poorer in alkali and richer in lime and magnesia than the other members of the series removes it so far as to place it in the subrang "andose," whereby its alkaline affinities are completely obscured.

Now N.15, a quartz-monzonite or akerite, an olivine-free rock, of light grey colour and even grain-size, has the same magmatic name as the orthoclase-sodalite-basalt, W.67, from the Warrumbungle Mountains (p.607), although the last-mentioned is a black,

* "Geology of Dunedin." Q.J.G.S. Vol.lxii.

basaltic, uneven-grained rock, containing olivine and titaniferous augite. Truly both these rocks are alkaline, but their facies, mode of occurrence, constitution, and origin are all so different that the system of classification which brings them together is most unnatural. The one type, N.15, is a hypabyssal rock derived by magmatic differentiation from an alkaline magma; the other is a volcanic rock which originated by *magmatic mixing.*

A system of rock-classification cannot be both chemical and mineralogical, and an attempt to create such a system must be futile. To separate the lime combined with alumina from that of diopside, calcite, and apatite in estimating the rang is also unnatural.

Personally, I favour adherence to the old nomenclature, but believe as well in having as many analyses as time will permit. To determine the norm is also highly desirable. A chemical analysis is almost as quickly made as Rosiwal measurements, and is much more reliable than calculating the norm from the mode.

Further, Rosiwal measurements are sheer waste of time unless the rock to be studied is *medium-* or coarse-grained, and of fairly even grain-size; in addition, its minerals should be of definite and known composition (as in granite and gabbro).

Volcanic Sequence.—As already stated the sequence observed in the Nandewar Mountains was—

(1) Injection of basic laccolites and sills as N.17; after which prolonged denudation.

(2) Eruption of arfvedsonite trachytes (N.30, N.59, N.55, etc.) and their tuffs.

(3) Earth-movements and intrusion of sills of pulaskite and nordmarkite porphyry, accompanied by eruptions of phonolite (N.11, N.10, N.49).

(4) Eruptions of andesite followed, and the sills of labradorite porphyry being of andesitic composition probably belong to this phase of activity (N.12).

(5) Flows of alkaline basalt, followed by normal basalt.

EXPLANATION OF PLATES.

Plate xlvi.

Geological Sketch Map of the Nandewar Mountains, and the country between the Nandewars and New England.

Plate xlvii.

Geological Sketch Map of the Nandewar Mountains only. Scale approximately 4 miles to the inch.

Plate xlviii.

Fig.1.—View of Ningadhun and Yullundunida from the Bullawa Creek Valley.

Fig.2.—View of the same from a point higher up in the hills. Sandstone formation in the foreground.

Plate xlix.

Fig.1.—View of the Lindesay Group from Bullawa Creek, five miles from the mountains.

Fig.2.—Scabby Rock, Pilliga Scrub.

Plate l.

Microphotographs of Nandewar Rocks (× 14, except fig.6 of Plate l., and fig.3 of Plate li.).

Fig.1.—Perlitic Pitchstone; Boggabri (N.62); nicols uncrossed.

Fig.2.—Dolerite; Dingo Creek (N.17); nicols uncrossed: the extinguished crystal is augite; the smaller bright crystal near it olivine.

Fig.3.—Sölvsbergite, Bullawa Creek (N.8), showing microperthitic felspar phenocrysts; nicols uncrossed.

Fig.4.—Pulaskite Porphyry; Oakey Creek (N.11); showing phenocryst of microcline microperthite near extinction, with zone of orthoclase.

Fig.5.—Bostonite; Dingo Creek (N.51); nicols crossed. Note peculiar cruciform twin.

Fig.6.—Akerite; Oakey Creek (N.15); nicols uncrossed. Note ægirine augite phenocryst (× 21).

Plate li.

Fig.1.—Labradorite Porphyry (N.12); nicols crossed.

Fig.2.—Arfvedsonite-Ægirine Trachyte (N.59); nicols uncrossed.

Fig.3.—Monzonose (phonolitic) (N.49); nicolls uncrossed (× 21).

Fig.4.—Andesite with Labradorite phenocrysts (N.33); near Deriah; nicols uncrossed.

Fig.5.—Phenocryst of Labradorite in alkaline basalt (N.23); nicols crossed.

Fig.6.—Akerite (N.15); nicols crossed.

Plate lii.

Figs.1*a*-*b*.—Handspecimen of Monchiquitic Lamprophyre.

Fig.2.—Handspecimen of Labradorite Porphyry.

(The figures of this Plate from photos by H. Gooch).

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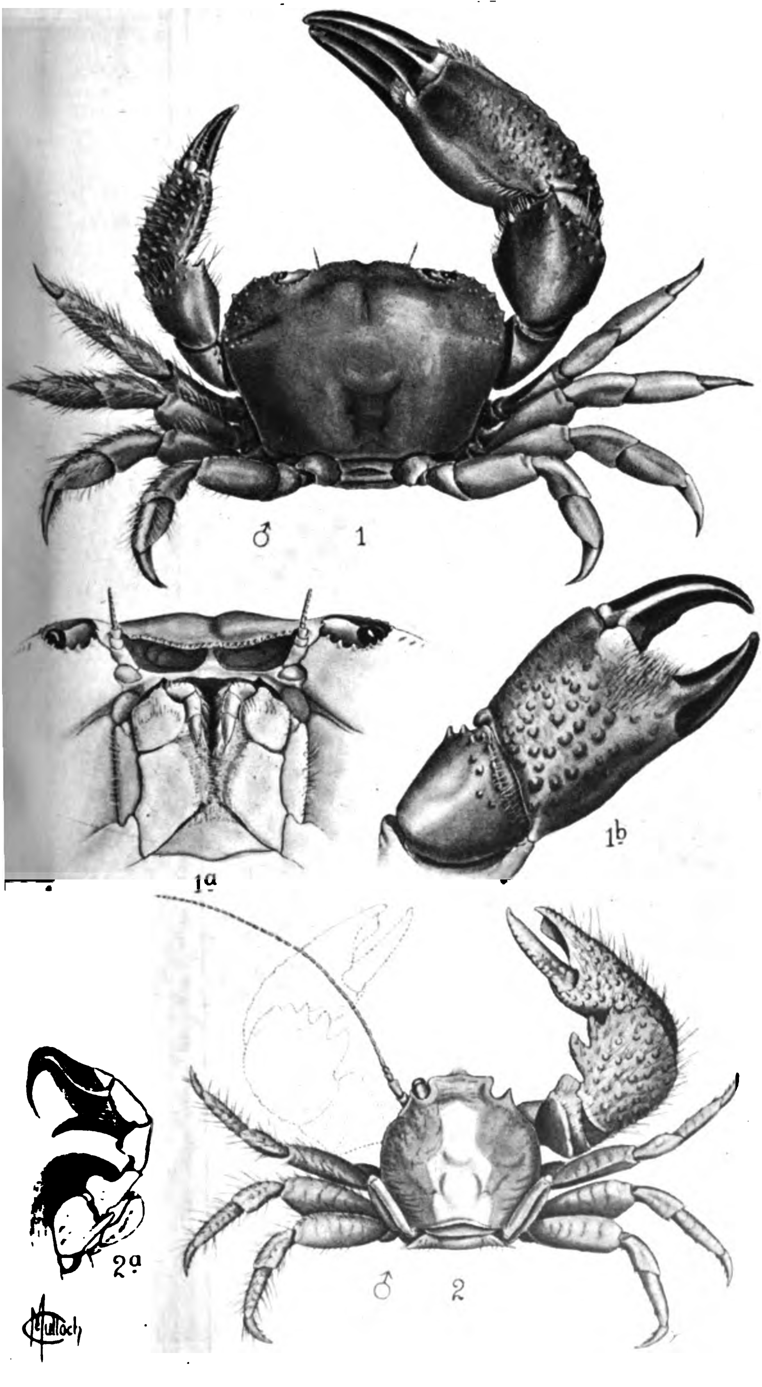
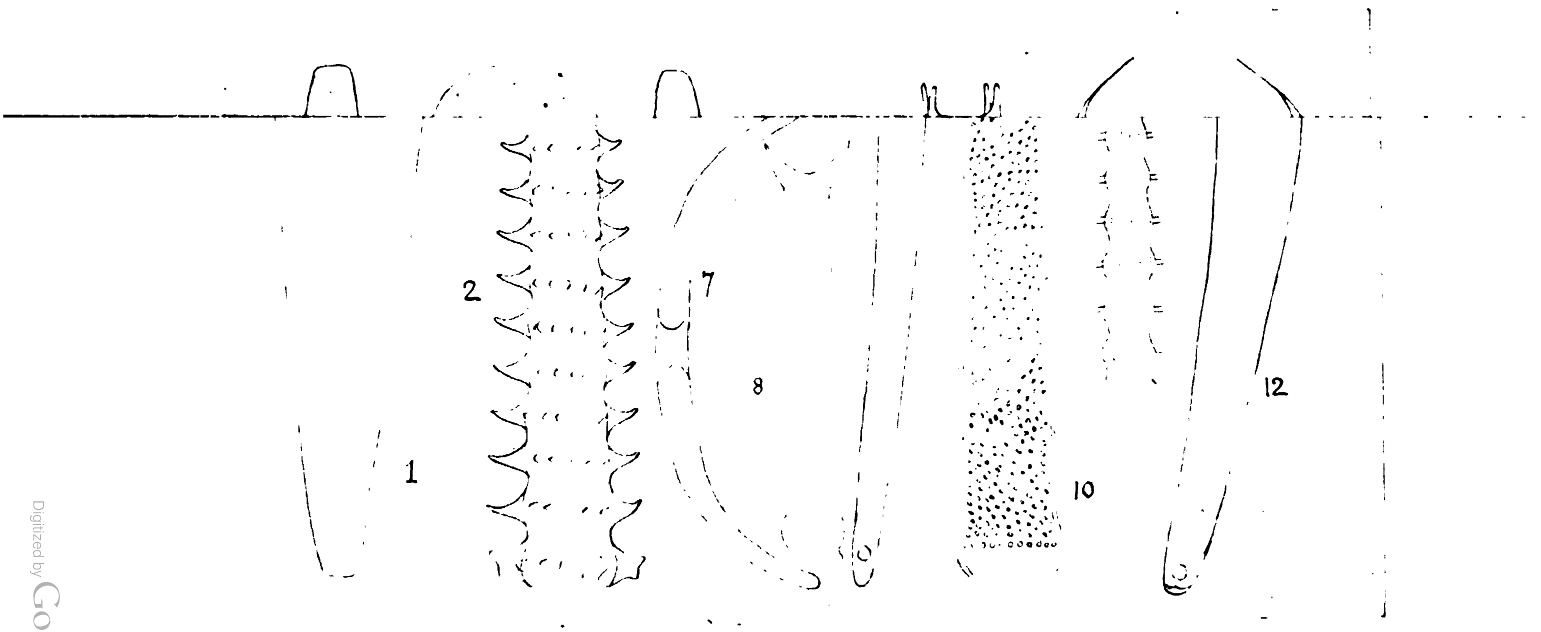


FIGS 1, 1a, 1b *ERIPHIA NORFOLCENSIS*, SP. N. FIGS 2, 2a, *PACHYCHELES LIFUENSIS* BORR



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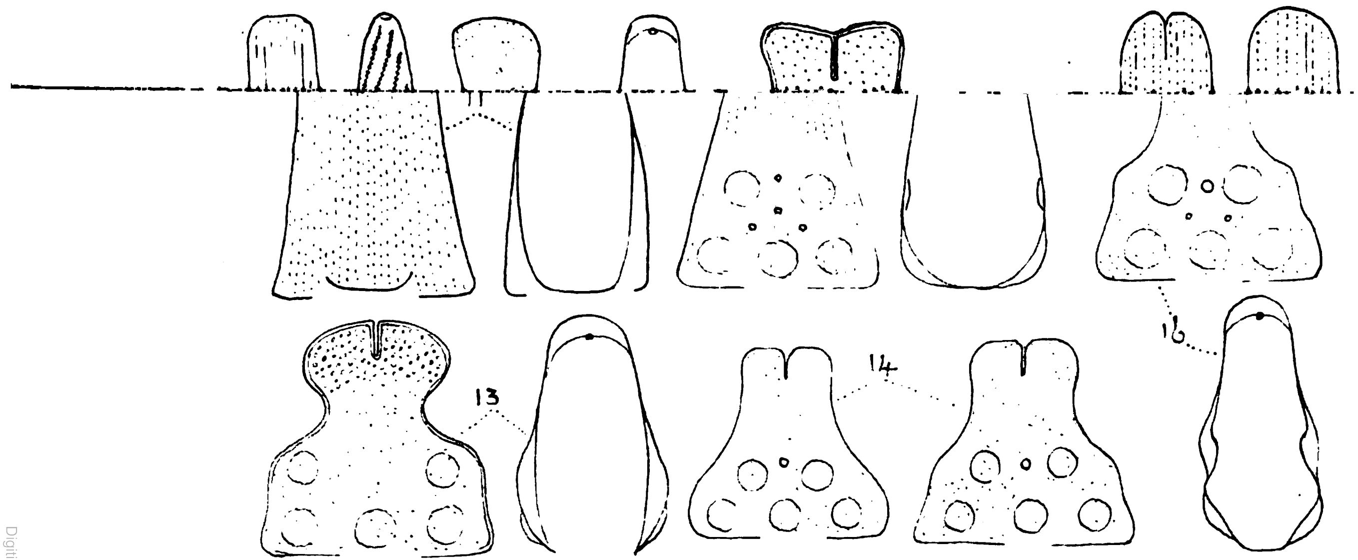

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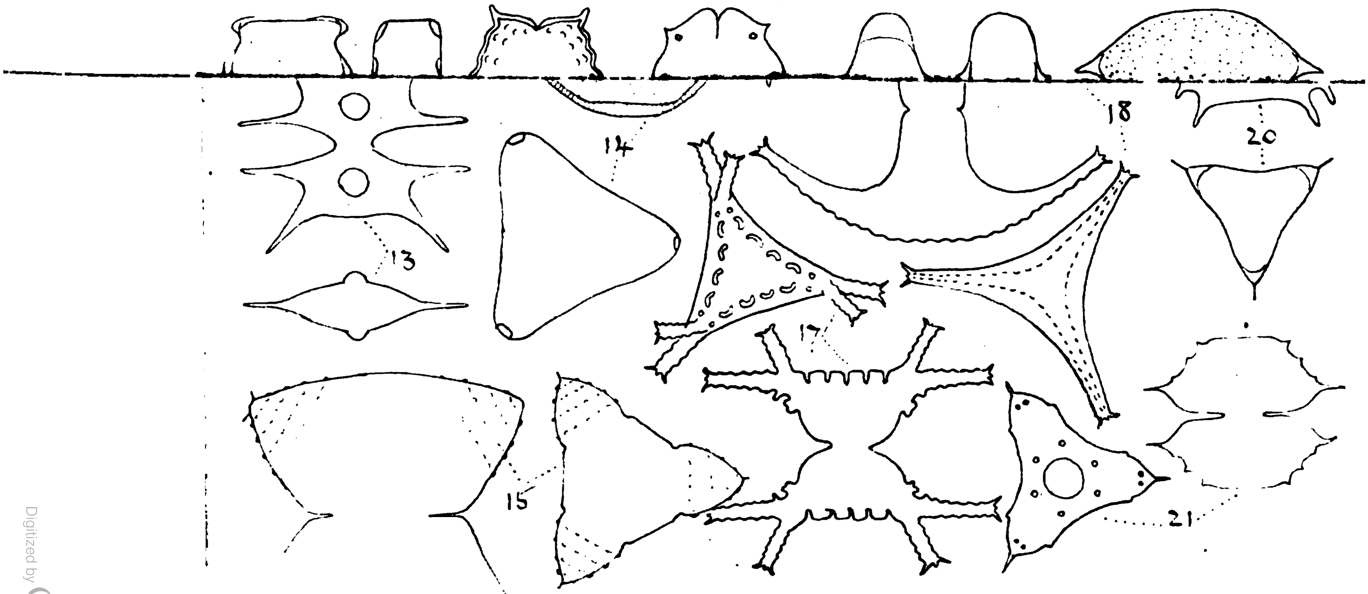

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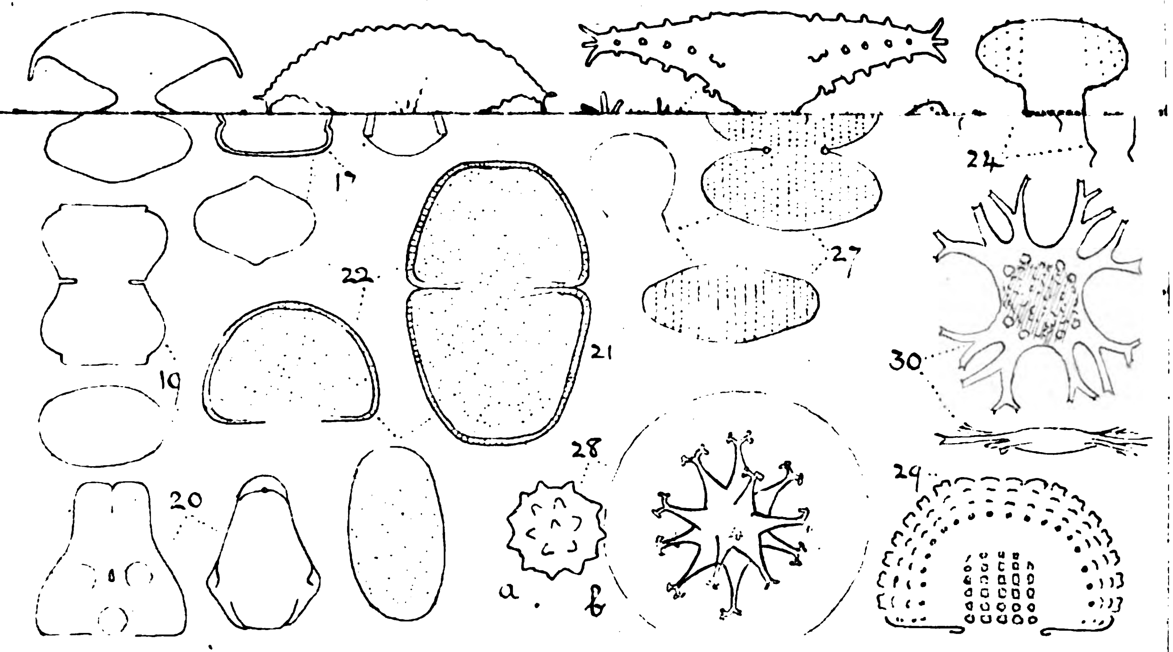

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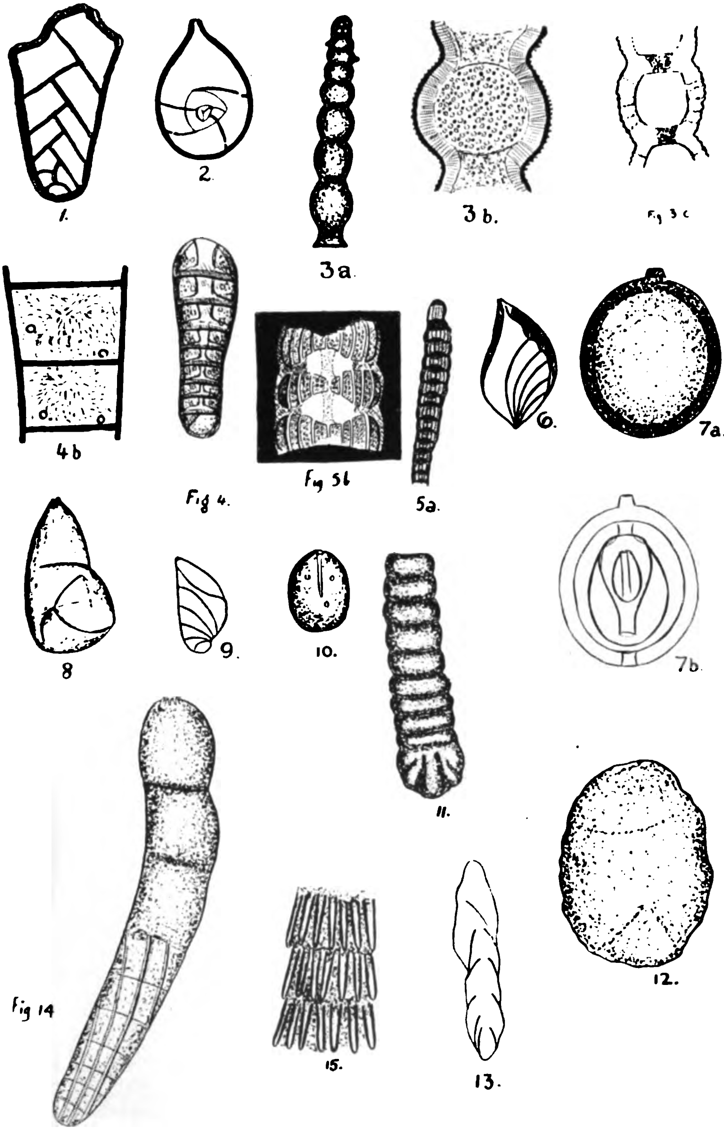

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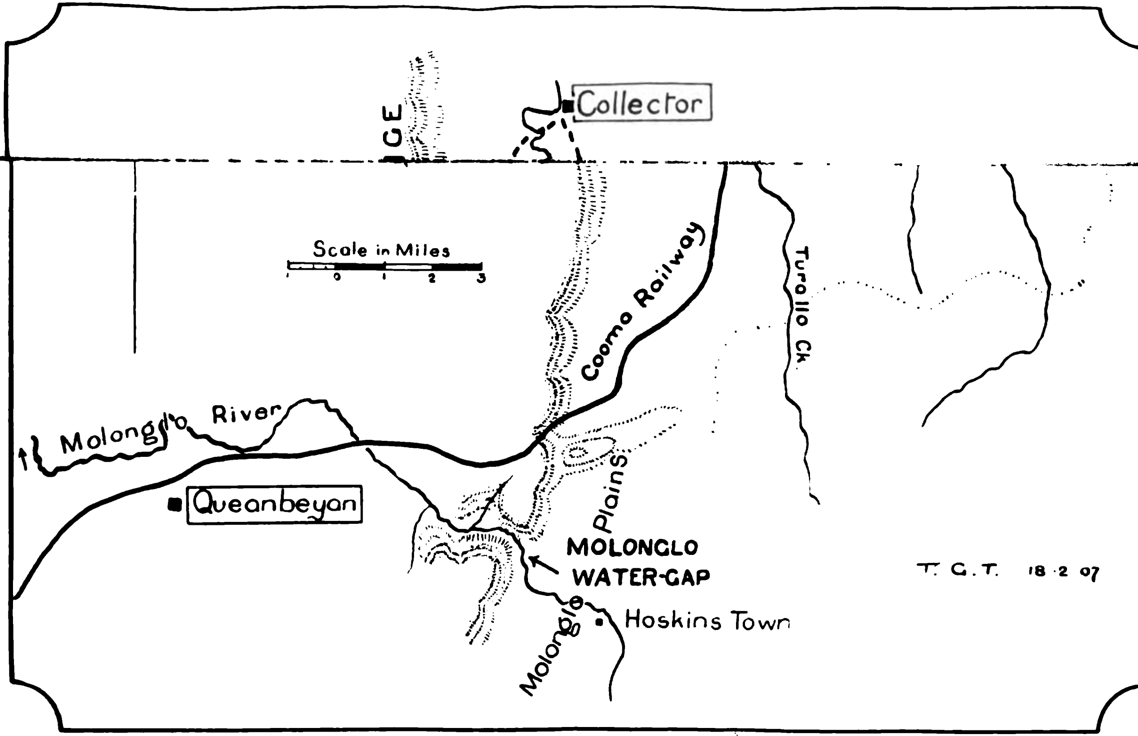
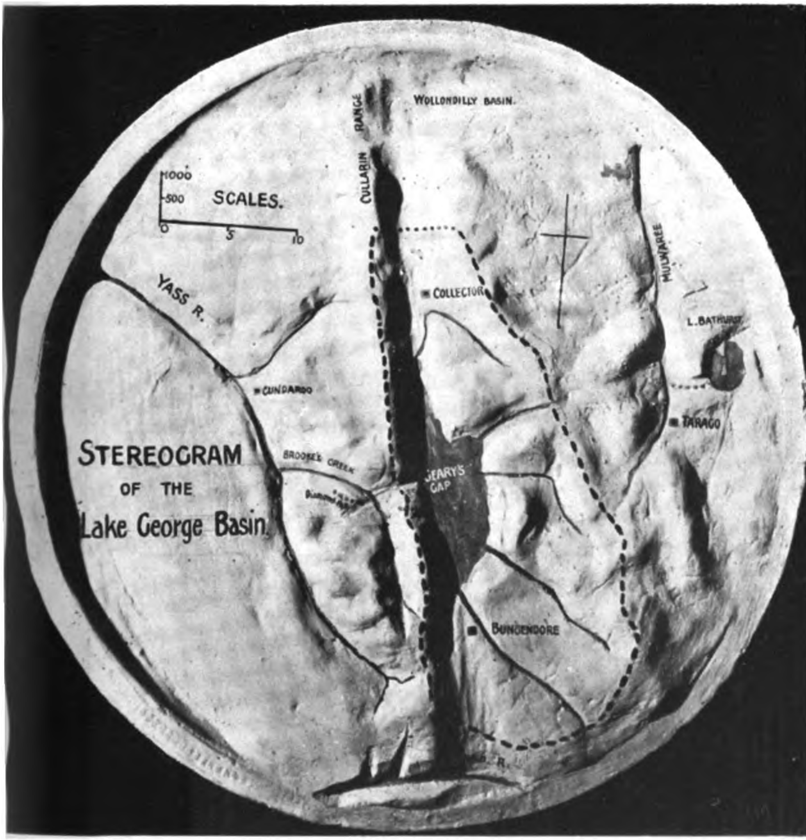


MAP OF THE LAKE GEORGE "SENKUNGSFELD" AND FAULT SCARP (CULLARIN RANGE).



STEREOGRAM OF LAKE GEORGE SHOWING FAULT SCARP AND DRAINAGE MODIFICATIONS.

VIEW OF THE DRY BED OF LAKE GEORGE IN FEBRUARY, 1907.

VIEW OF LAKE GEORGE IN 1884, WHEN NEARLY FULL OF WATER

FIG. 2. VOMA AT THE HEAD OF THE WAIDINA RIVER.

FIG. 1. KOROBASABASAGA FROM THE EAST

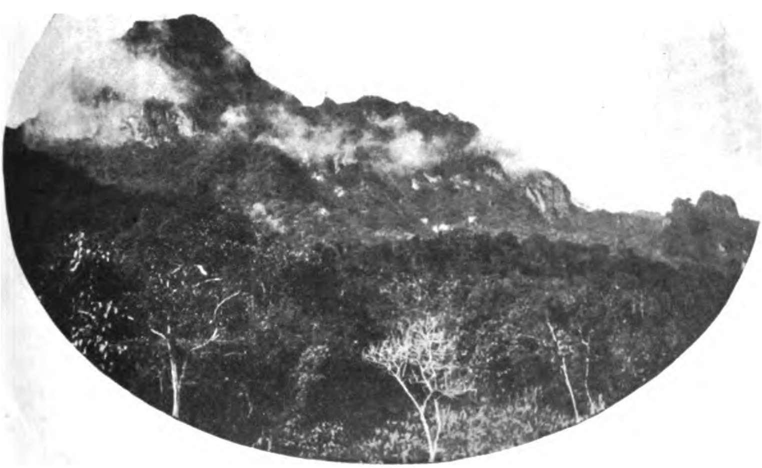


FIG. 2. VOMA AT THE HEAD OF THE WAIDINA RIVER.

FIG. 1. NABUI ON THE WAINIKOROILUVA RIVER.

FIG. 2. UPPER WAIDINA VALLEY.

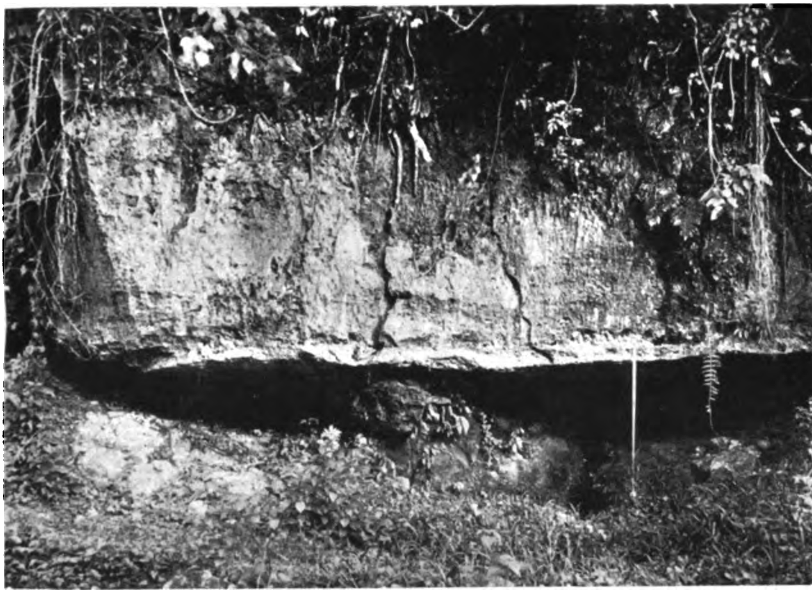
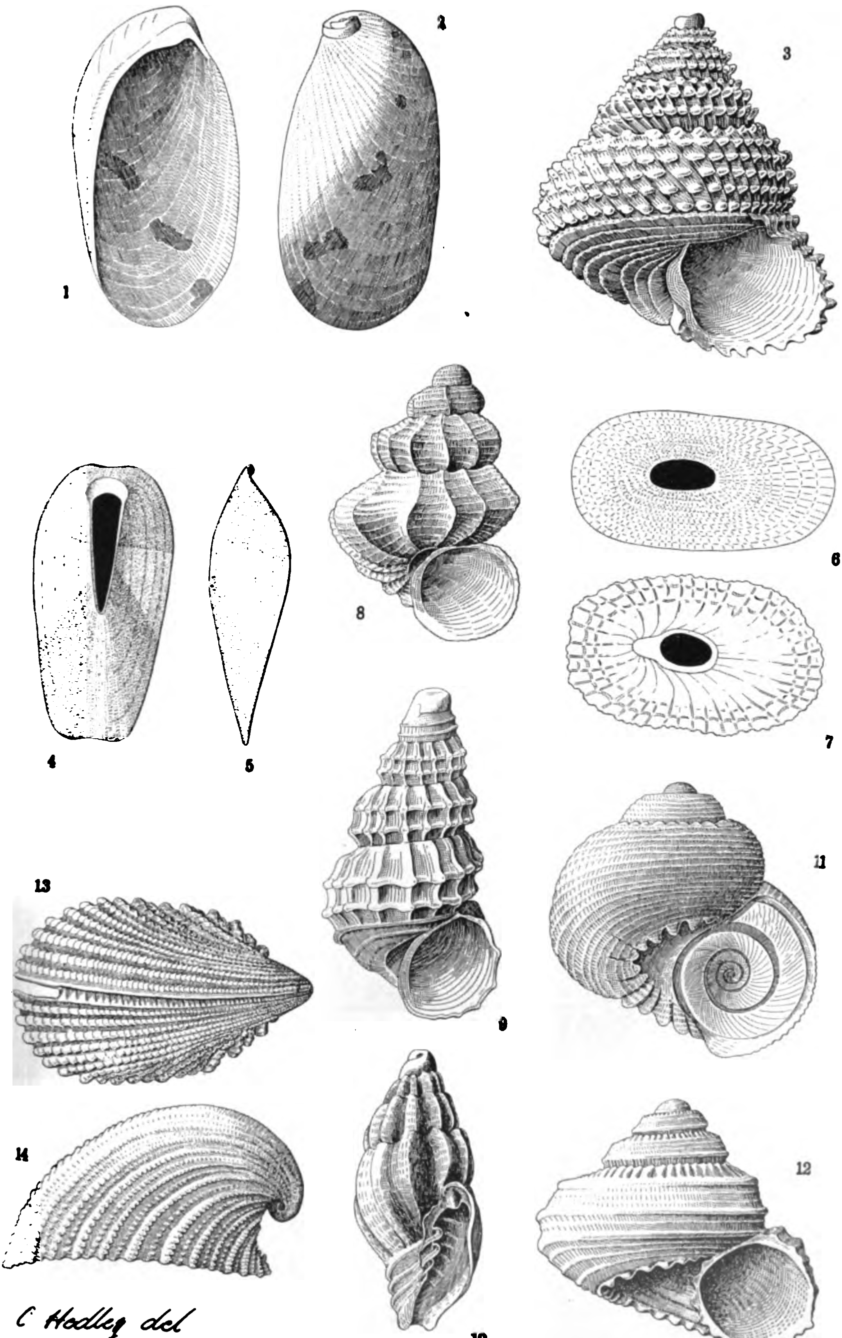
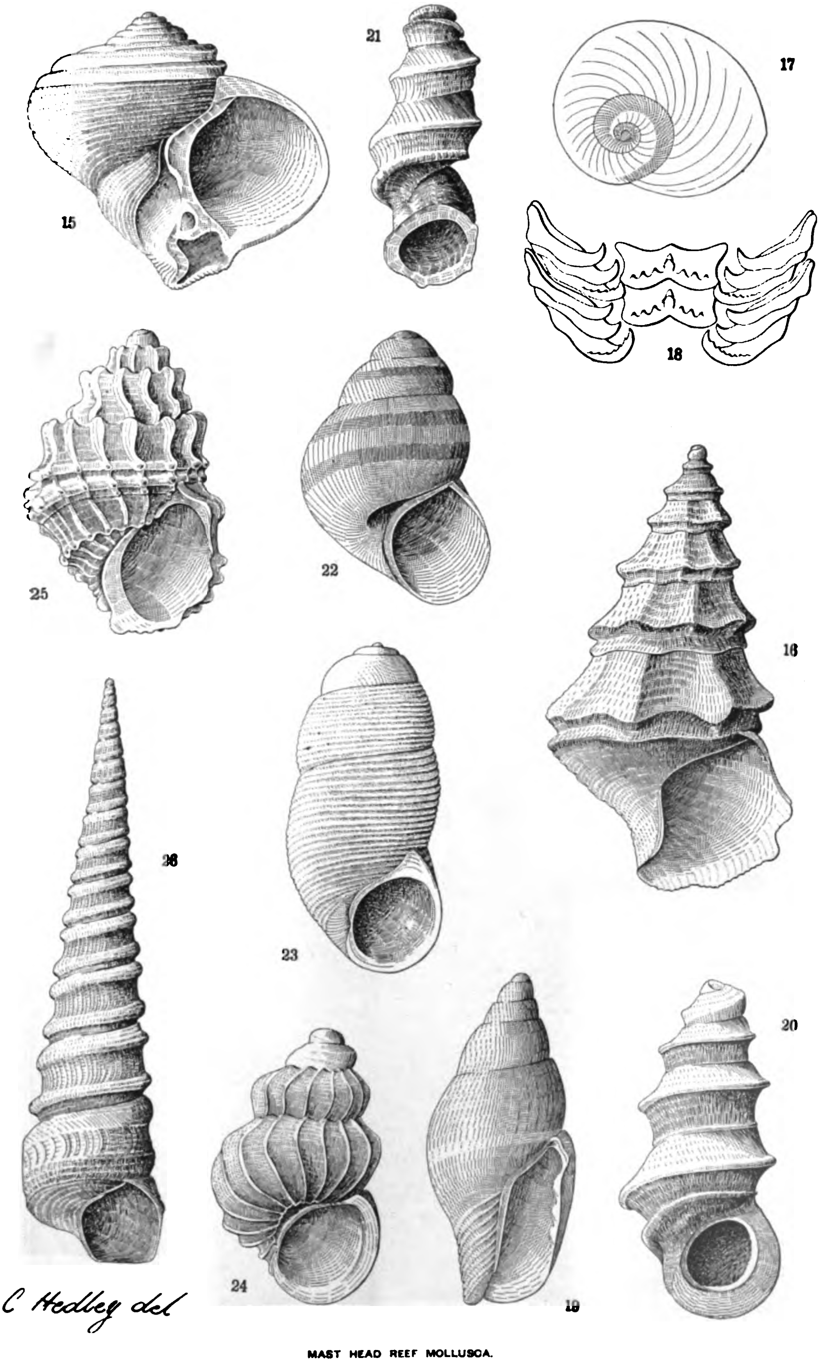


FIG. 1. SECTION OF UPRAISED (TERTIARY) CORAL REEF AT SUVA.

FIG. 2. SECTION OF UPRAISED (TERTIARY) CORAL REEF AT SUVA.



MAST HEAD REEF MOLLUSCA.



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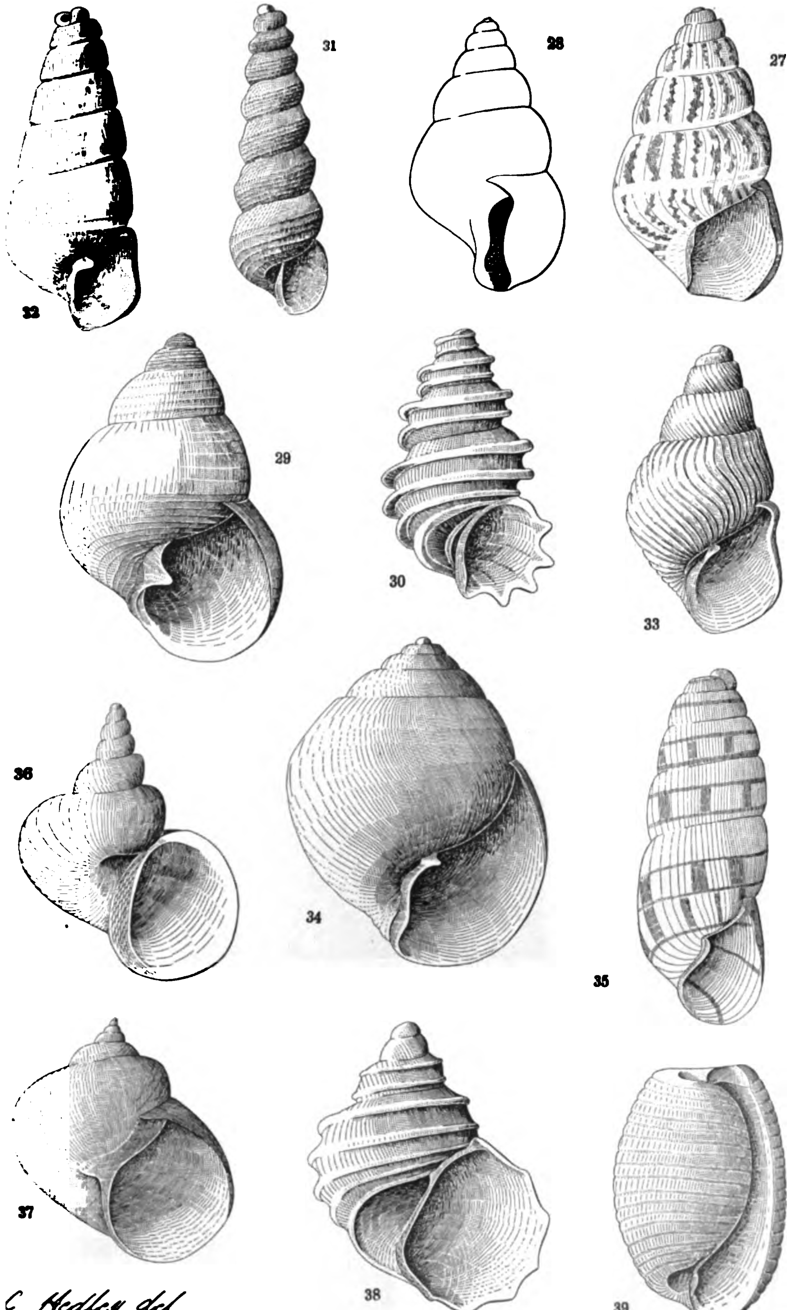

MAST HEAD REEF MOLLUSCA.

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A. R. McCulloch del.

MAST HEAD REEF MOLLUSCA.

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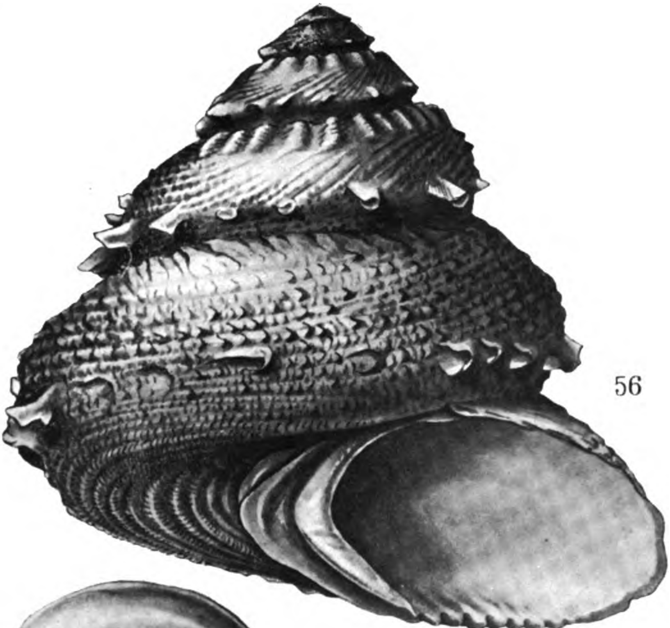
MAST HEAD REEF MOLLUSCA.



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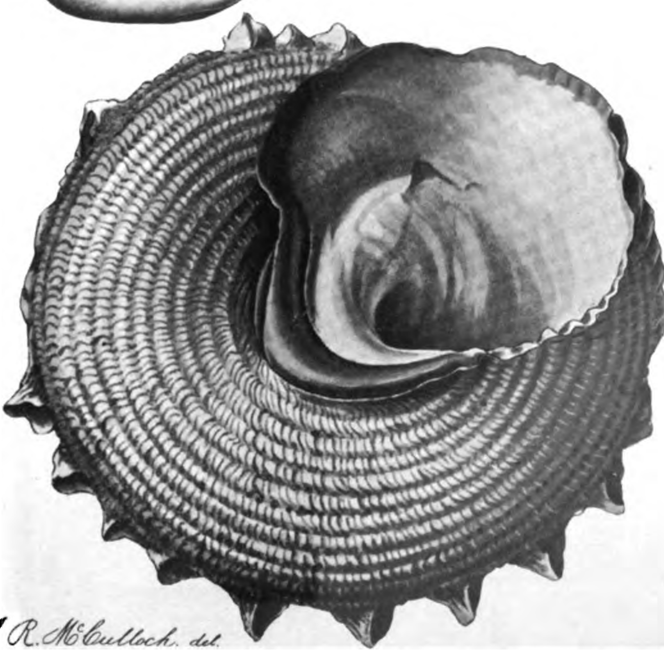

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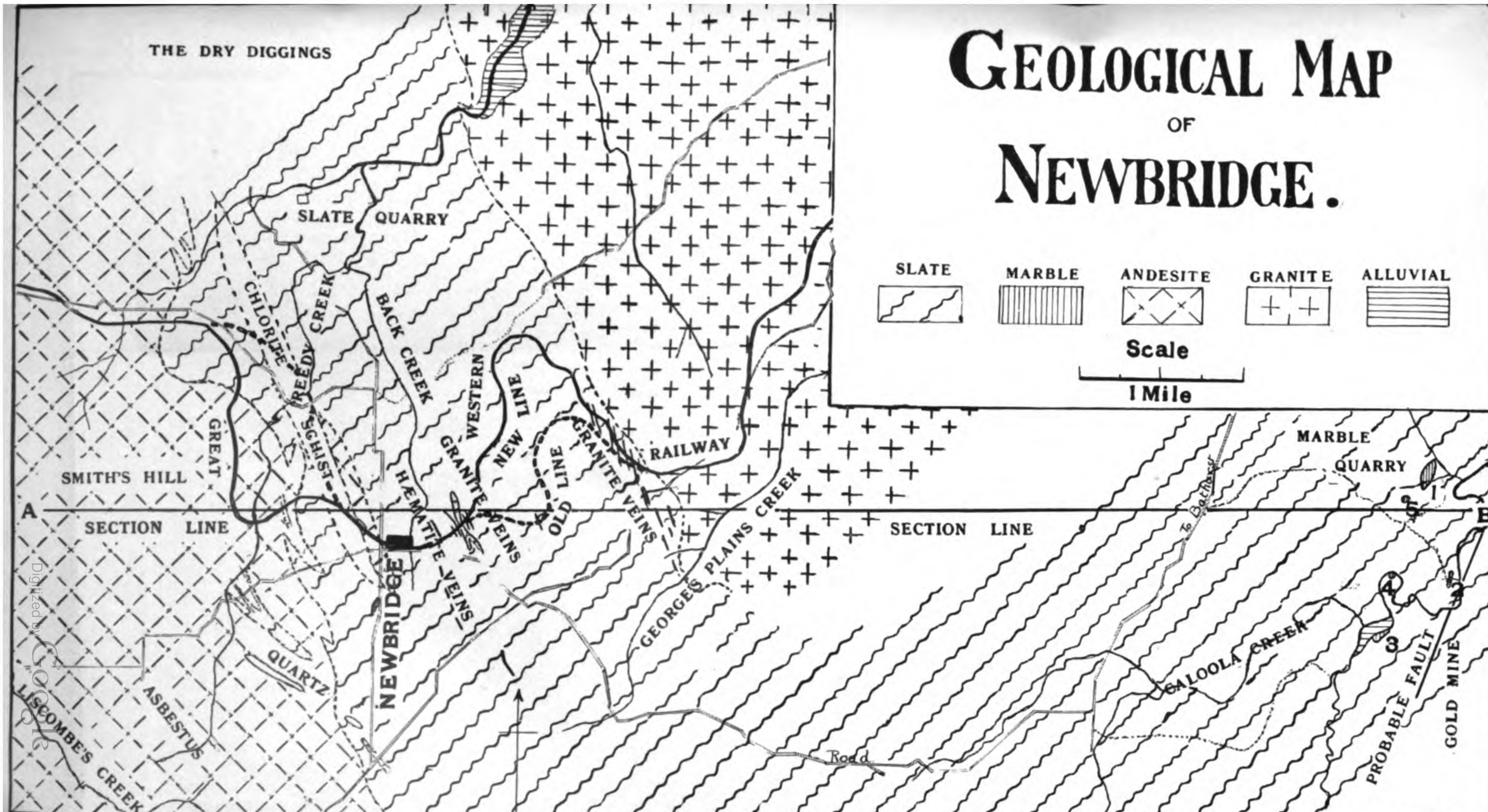
A. R. McCulloch. del.

MAST HEAD REEF MOLLUSCA.


GEOLOGICAL MAP
OF
NEWBRIDGE.
SLATE
MARBLE
ANDESITE
GRANITE
ALLUVIAL
Scale
1 Mile
THE DRY DIGGINGS
SLATE QUARRY
CHLORITE
REEDY CREEK
BACK CREEK
SCHIST
GREAT
SMITH'S HILL
A
SECTION LINE
NEWBRIDGE
HÆMATITE VEINS
GRANITE VEINS
WESTERN
NEW LINE
OLD LINE
GRANITE VEINS
RAILWAY
GEORGES PLAINS CREEK
SECTION LINE
B
QUARTZ
ASBESTUS
LISCOMBE'S CREEK
to Bathurst
MARBLE
QUARRY
CALOOLA CREEK
Road
PROBABLE FAULT
GOLD MINE
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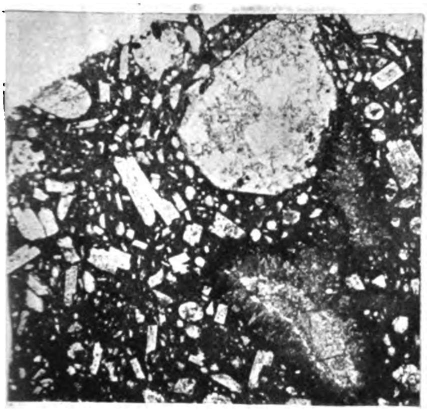

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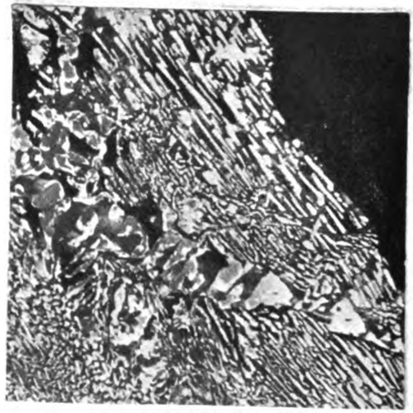

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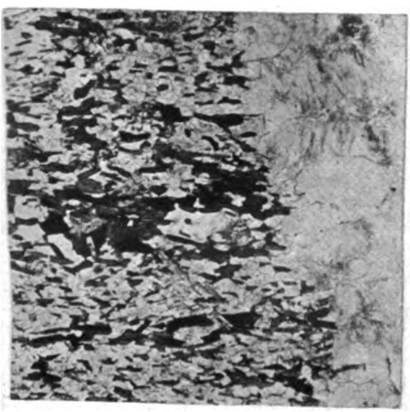

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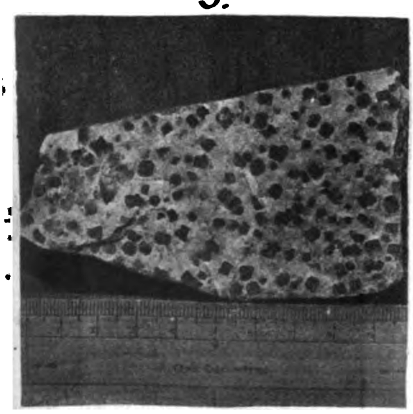

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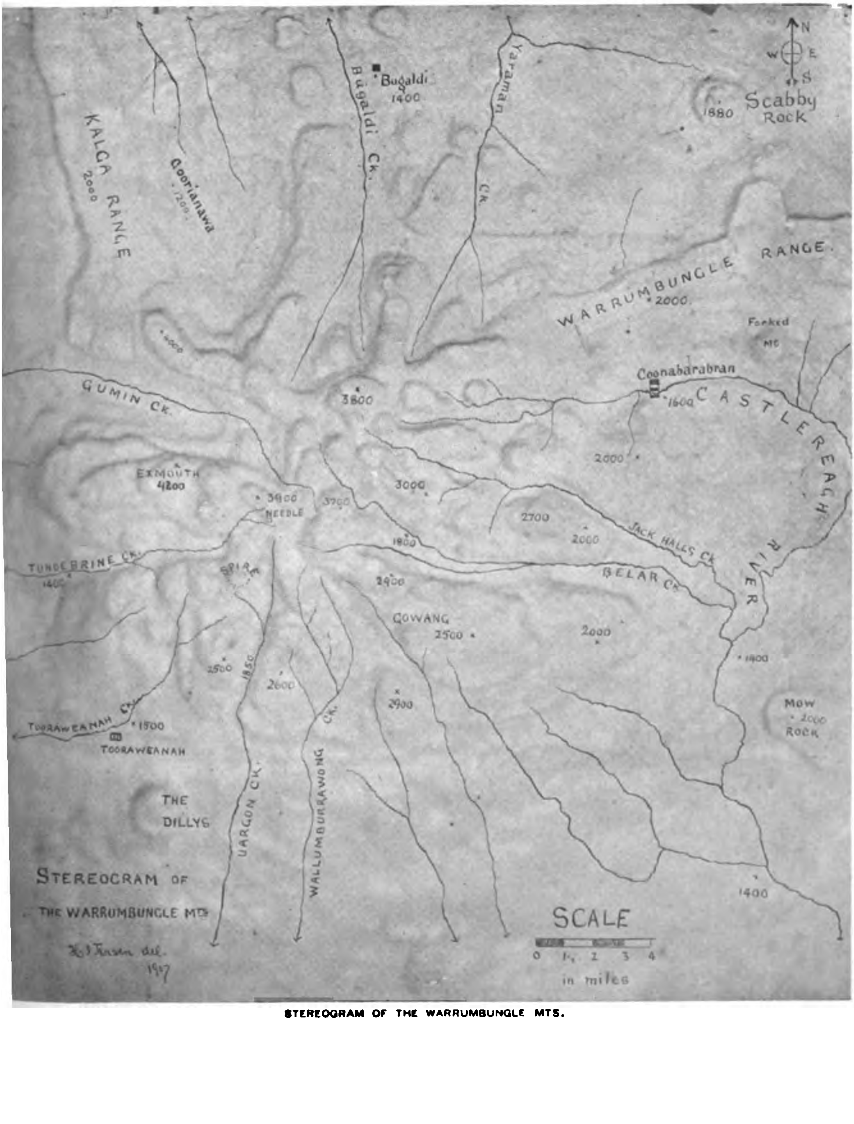
NEWBRIDGE ROCKS.

FIG. 1. ANDESITE. FIG. 2. GRANOPHYRE. FIG. 3. JUNCTION OF MICA SLATE AND GRANITE.
FIG. 4. JUNCTION OF MICA SLATE AND GRANOPHYRE. FIG 5-6. CHIASTOLITE SLATE.

xxv.



STEREOGRAM OF THE WARRUMBUNGLE MTS.

FIG. 1. BULLEAMBLE MOUNTAINS FROM SIDING SPRING MTN.

FIG. 2. THE SPIRE (TONDURON) FROM NEEDLE MTN.

FIG. 1. THE NEEDLE AND MOUNTAINS BEYOND IT, FROM NEEDLE MTN.

FIG. 2. VIEW FROM SIDING SPRING MTN., LOOKING NORTH.

FIG. 1. BUGALDI VALLEY AND WHEOH MTN., FROM SIDING SPRING MTN.

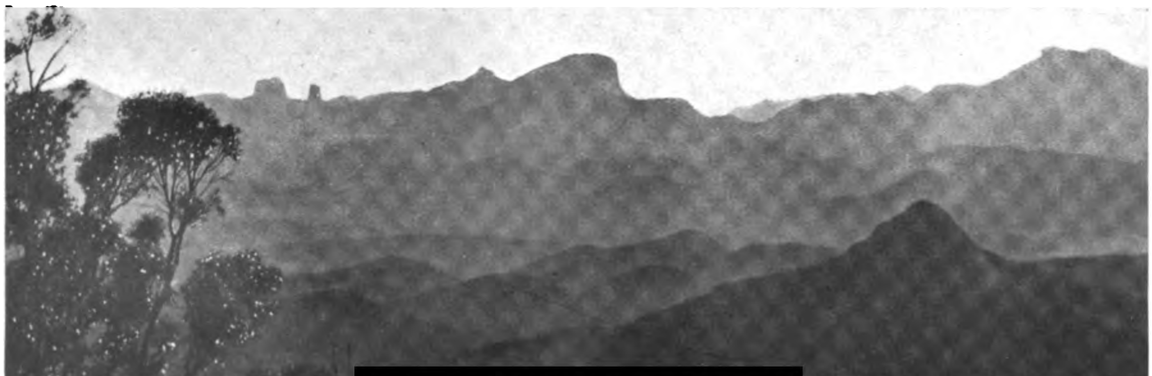
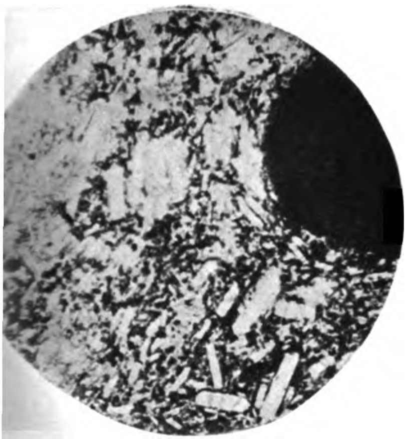


FIG. 2. THE BLUFF AND MT. EXMOUTH FROM SIDING SPRING MTN.

FIG. 1. SIDING SPRING MTN., HIGH PEAK, &C., FROM NEEDLE MTN.

FIG. 2. A SANDSTONE "MESA" NEAR BARRADINE CREEK.



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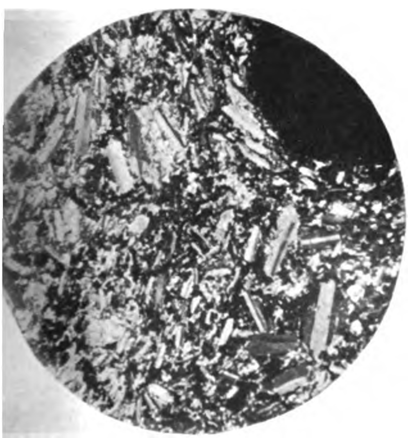

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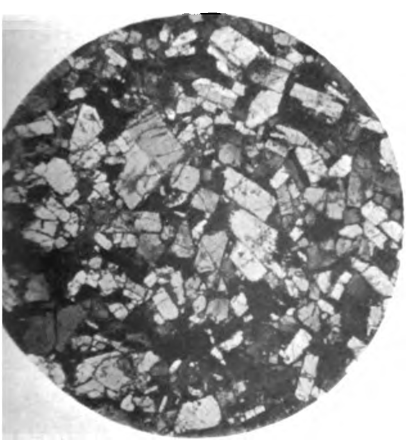

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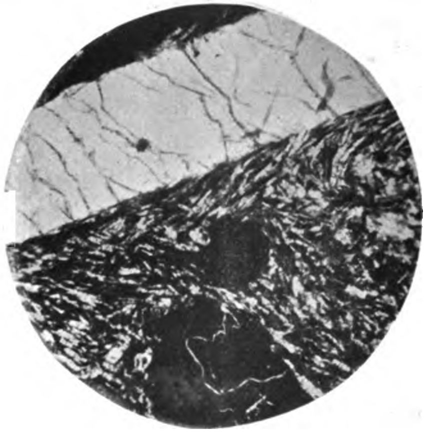

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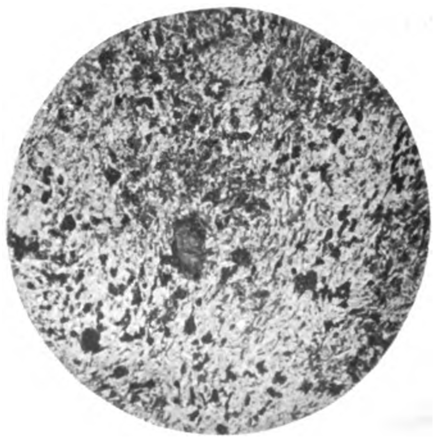

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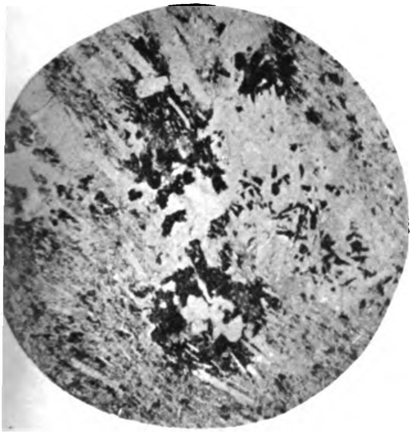
6

TRACHYTES (WARRUMBUNGLE MTS.).



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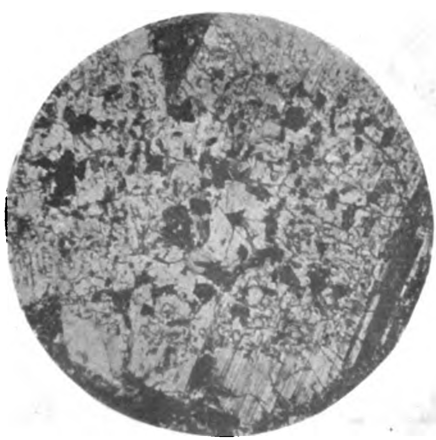
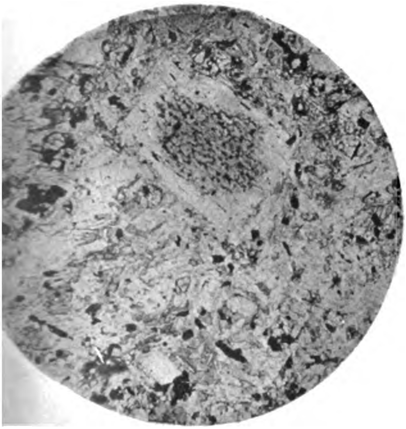


6

PHONOLITE, LEUCITOPHYRE, AND BASALT (WARRUMBUNGLE MTS.).



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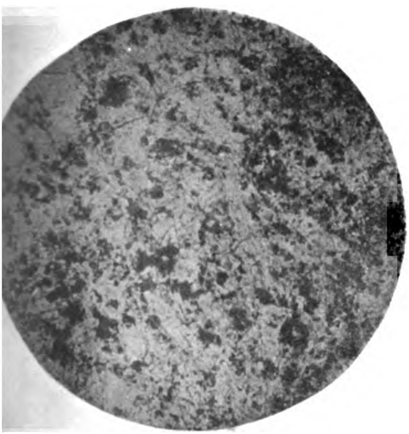
N.1



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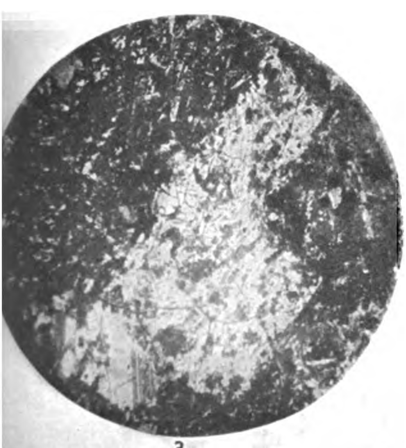
N 2



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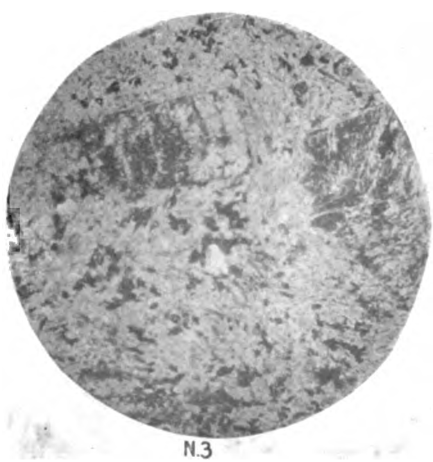

N.3

FIGS. 1-3. BASALT (WARRUMBUNGLE MTS.).

FIGS. N1-3. PITCHSTONE, &C. (NANDEWAR MTS.).

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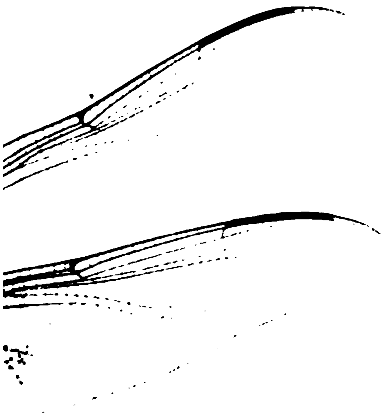
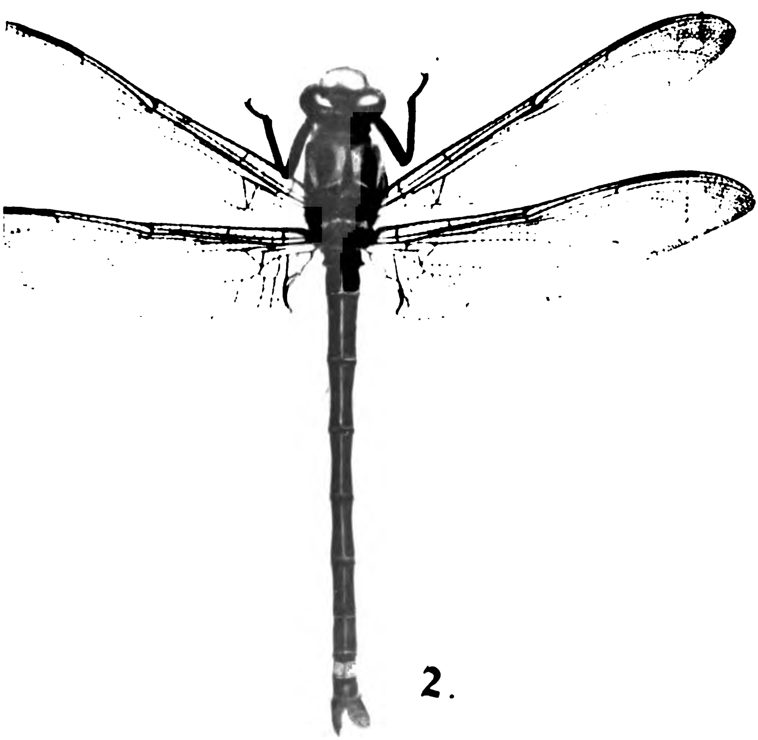
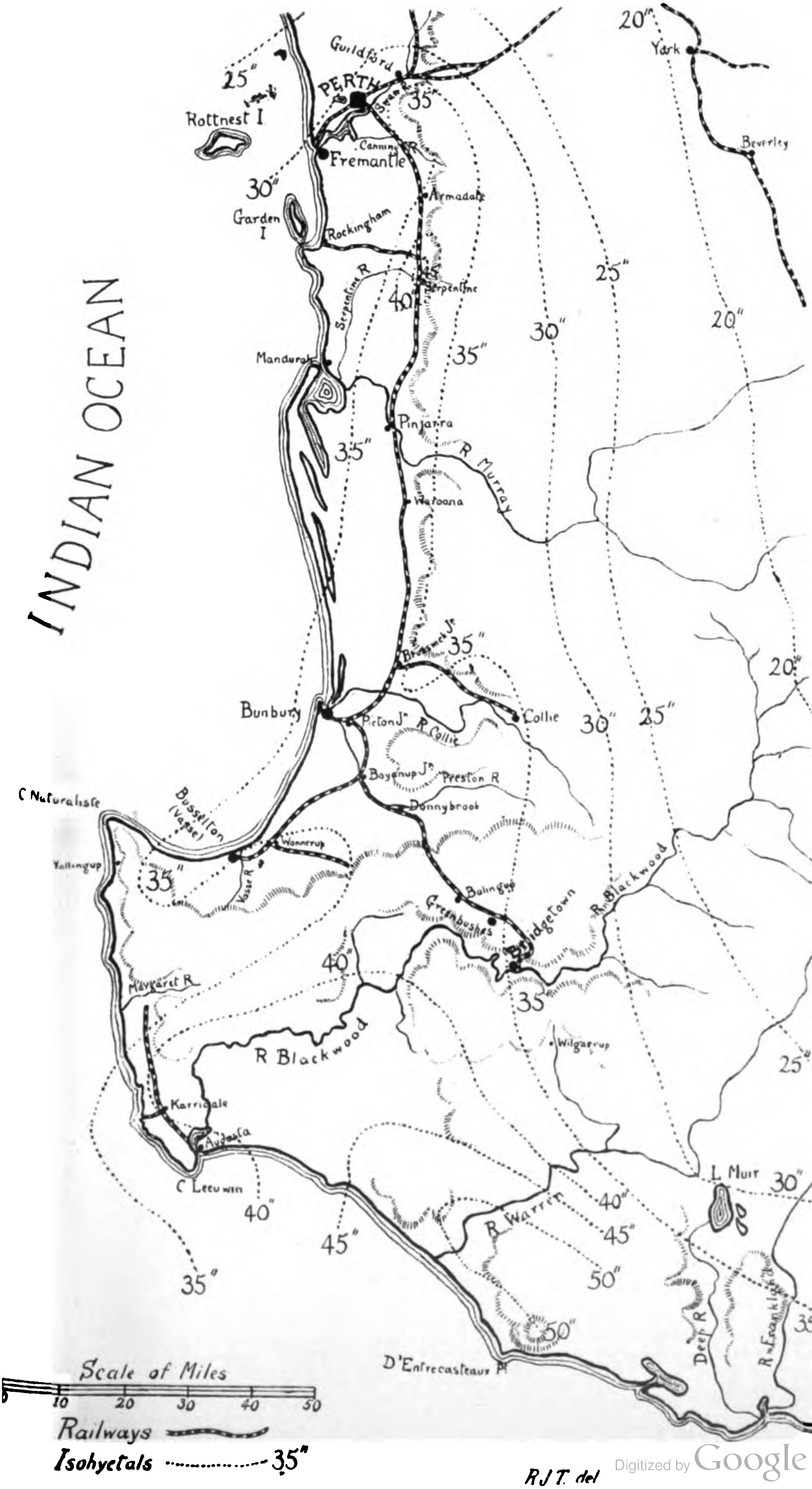
FIGS. 1, 3, 4. PETALURA INGENTISSIMA, N. SP.

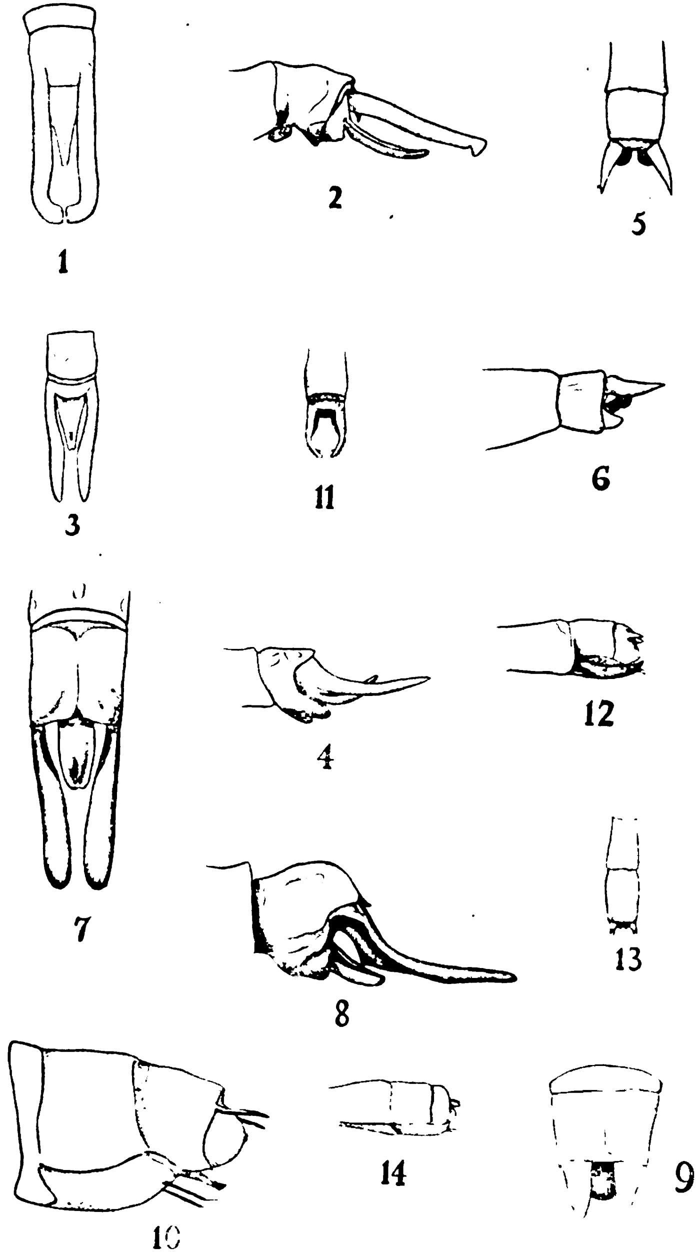




2.

FIGS. 2. 5. 6. PETALURA GIGANTEA, LEACH


INDIAN OCEAN
Guildford
PERTH
Swan R
Rottnest I
Canning R
Fremantle
Armadale
Garden I
Rockingham
Serpentine R
Serpentine
Mandurah
Pinjarra
R Murray
York
Beverley
Bunbury
Picton Jn
R Collie
Collie
Boyanup Jn
Preston R
Donnybrook
C Naturaliste
Busselton (Vasse)
Wonnerup
Yallingup
Vasse R
Balingup
Greenbushes
Bridgetown
R Blackwood
Margaret R
Wilgarrup
R Blackwood
Karridale
Augusta
C Leeuwin
R Warren
L Muir
Deep R
R Frankland
D'Entrecasteaux Pt
Scale of Miles
0 10 20 30 40 50
Railways
Isohyetals 35"
RJT del



1-3. SYNTHEMIS MARTINI N. SP.
5-6. AUSTROGOMPHUS OCCIDENTALIS.
11-12. ARGIOLESTES MINIMA, N. SP.
3-4. S. CYANITINCTA, N. SP.
7-10. AUSTROÆSCHNA ANACANTHA, N. SP.
13-14. PSEUDAGRION CŒRULEUM, N. SP.

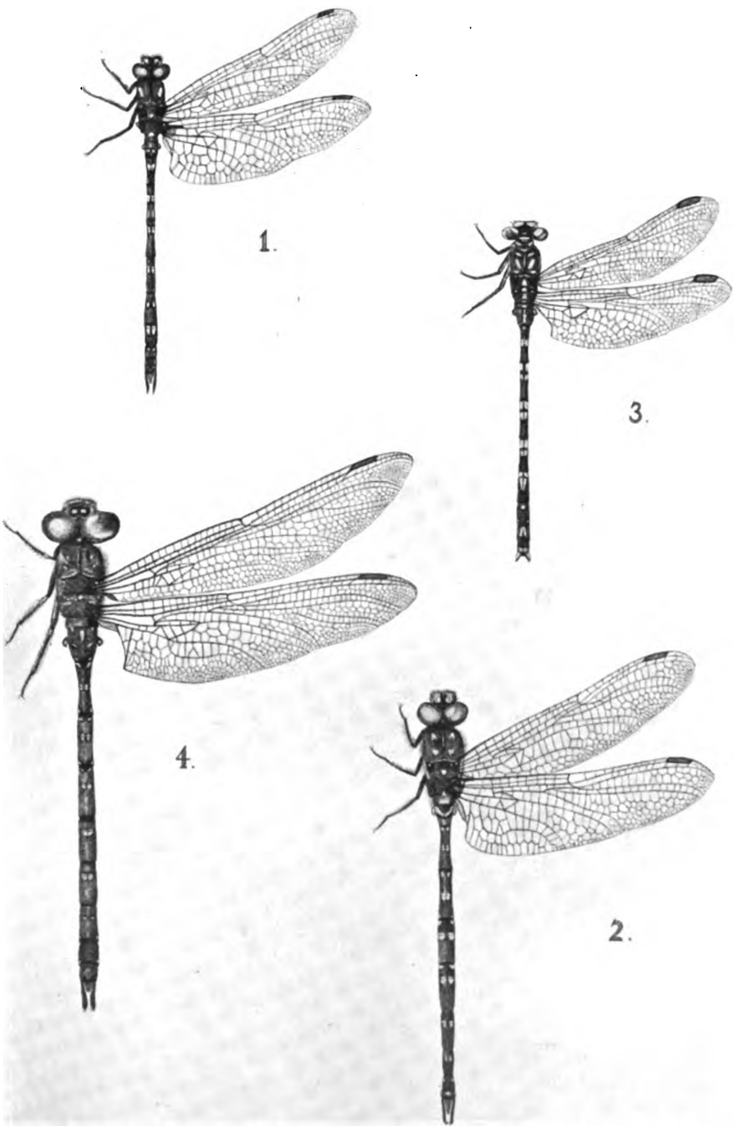


FIG. 1. SYNTHEMIS CYANITINCTA, N. SP.
FIG. 2 S. MARTINI, N. SP.
FIG. 3. AUSTROGOMPHUS OCCIDENTALIS N. SP.
FIG. 4. AUSTROÆSCHNA ANACANTHA, N. SP.

Fig. 1 (× 14)

Fig. 2 (× 14)

F.C. photomicr.

MIOCENE FORAMINIFERAL LIMESTONES : MALEKULA

Fig. 3 (x 14)

Fig. 5 (x 28)

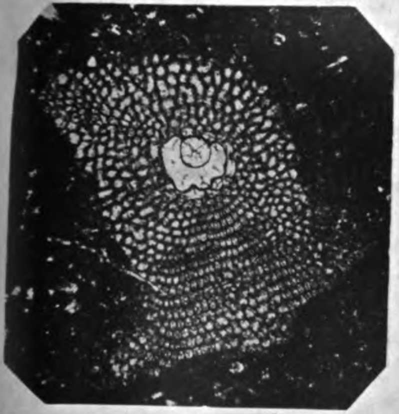


Fig. 4 (x 14)

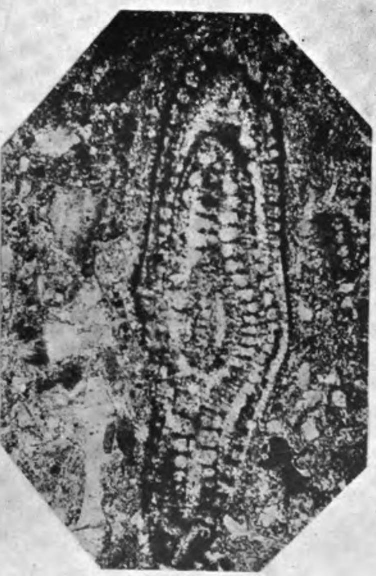


Fig. 6 (x 28)

Fig. 7 (×28)

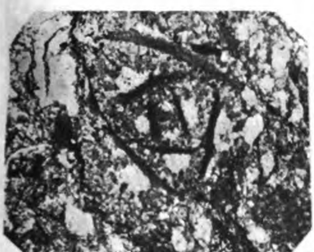


Fig. 8 (×28)

Fig. 9 (×28)

Fig. 10 (×14)

F.C. photomicr.

FORAMINIFERA (TRILLINA & LEPIDOCYCLINA) FROM THE OLDER LIMESTONES; MALEKULA, NEW HEBRIDES.

Fig. 11 (×36)

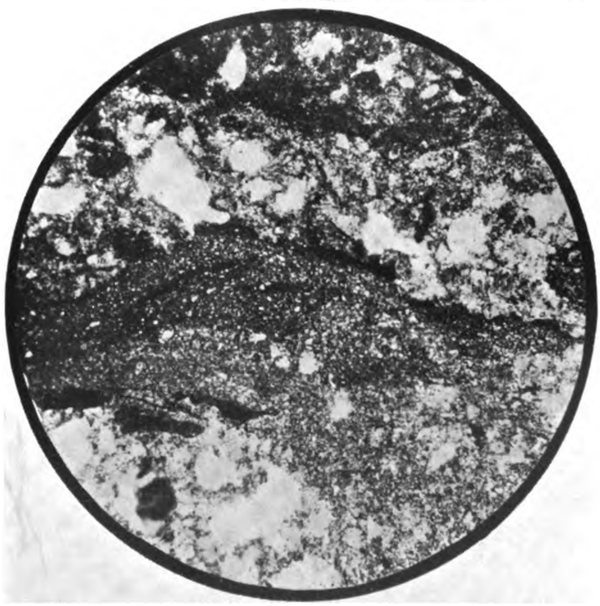


Fig. 12 (×28)

F.C. photomicr.

ENCRUSTING ORGANISMS IN THE POST-MIOCENE LIMESTONES: MALEKULA, NEW HEBRIDES.

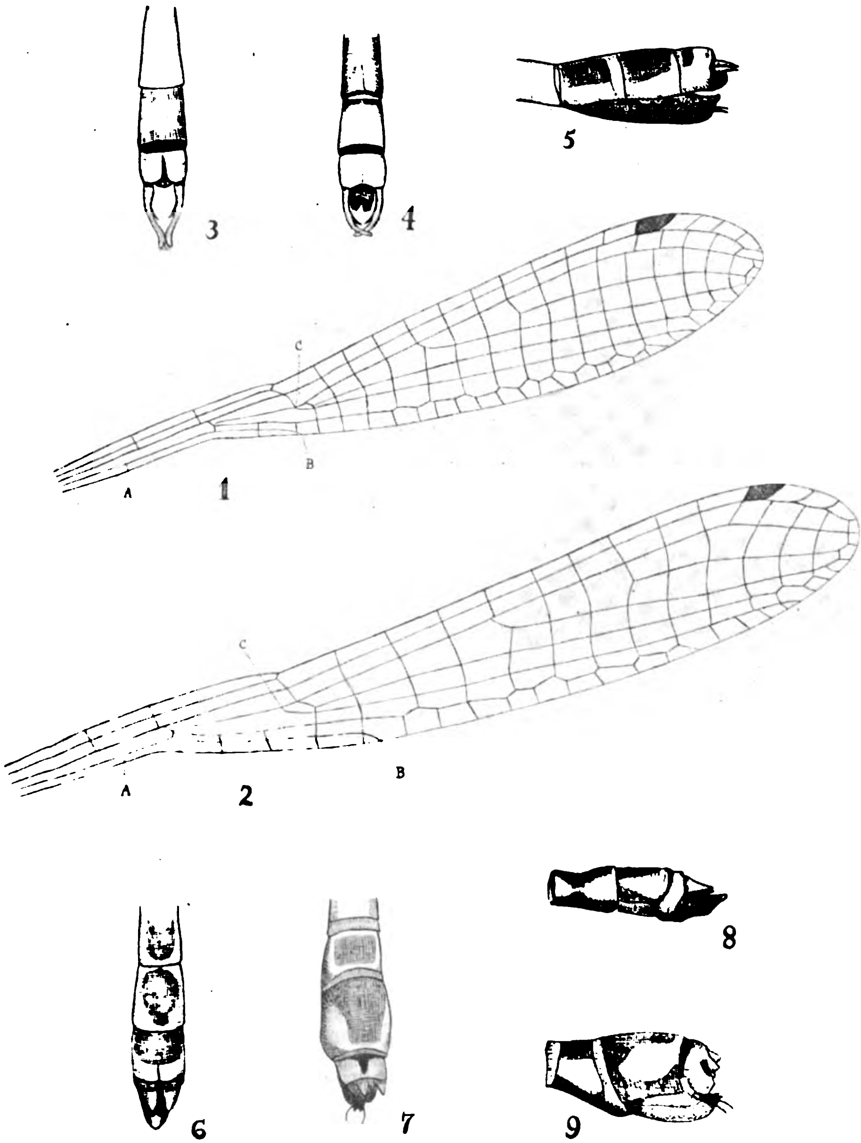
Fig. 13 (× 36)

Fig. 14 (× 36)

Fig. 15 (× 14)

F.C. photomicr.

FORAMINIFERA ETC. IN POST-MIOCENE LIMESTONES:
MALEKULA, NEW HEBRIDES.



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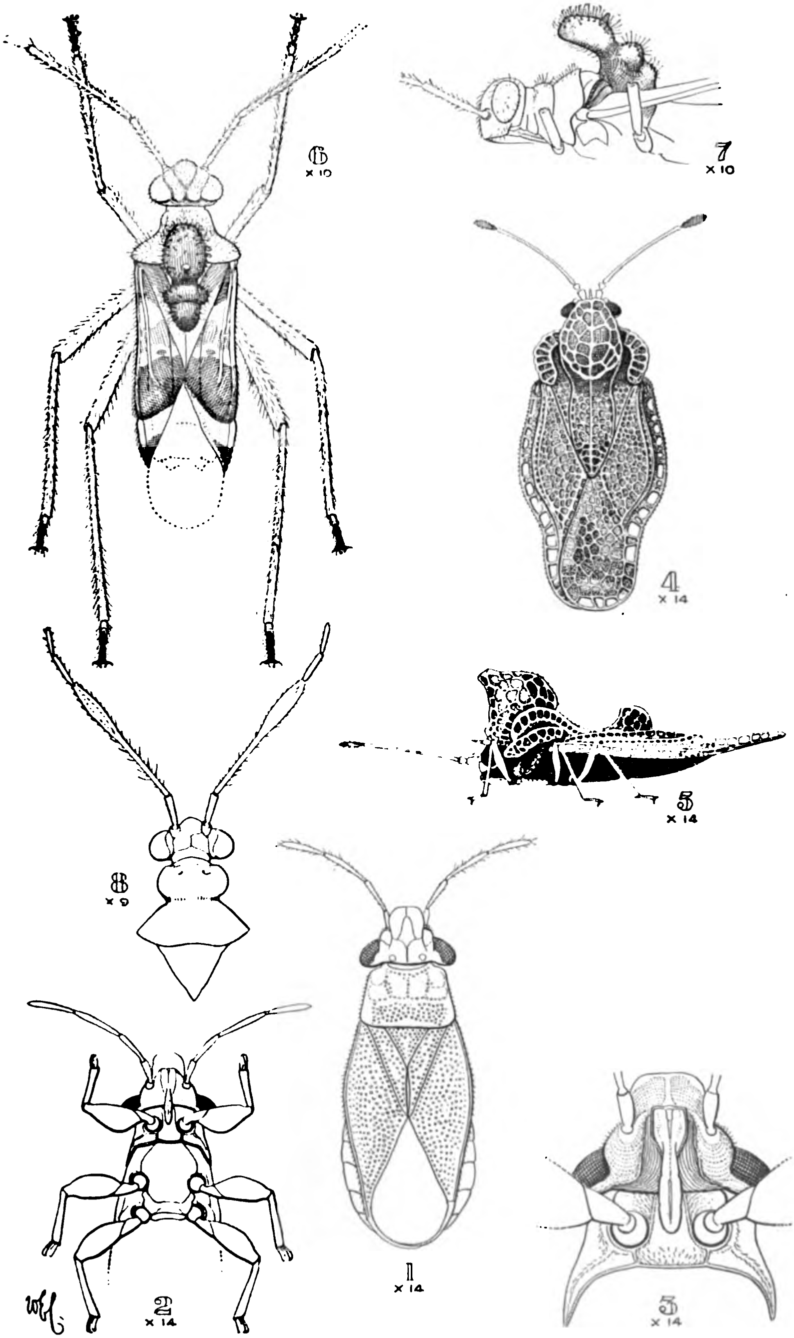
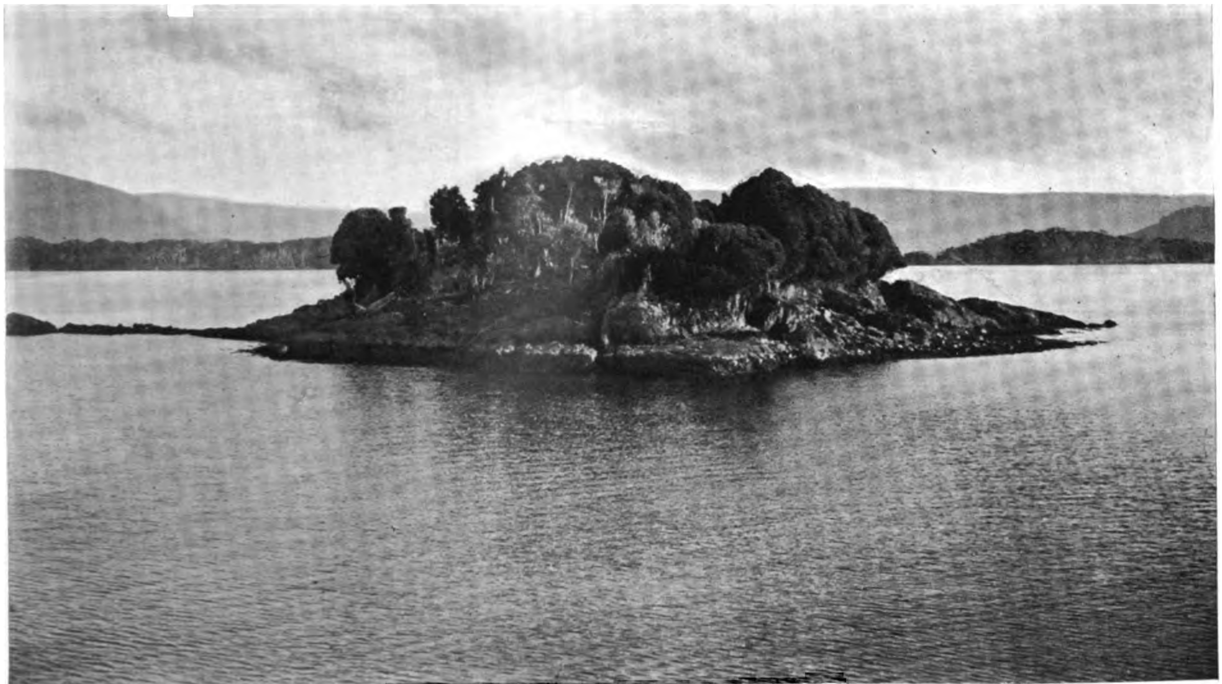
CENTRAL AUSTRALIAN DRAGONFLIES.



1-3. THAUMASTOCORIS (THAUMASTOTHERIUM *IN THE TEXT*) AUSTRALICUS, GEN. ET SP. N.
4-5. HYPSIPYRGIAS TELAMONIDES, GEN. ET SP. N. 6-7. CYSTEORRHACA CACTIFERA, GEN ET SP. N.
8. SYNTHLIPSIS CHAMBERSI, GEN. ET SP. N.

JUNCTION OF THE ARTHUR AND CLEDDAU RIVERS, MILFORD SOUND, N.Z. EXHIBITING CANYON-CONVERGENCE (P. 818).



PRESERVATION INLET N.Z. EXHIBITING CANYON-DIVERGENCE (P. 819).

FIG. 1. VIEW OF NINGADHUN AND YULLUNDUNIDA FROM BULLAWA CREEK VALLEY.

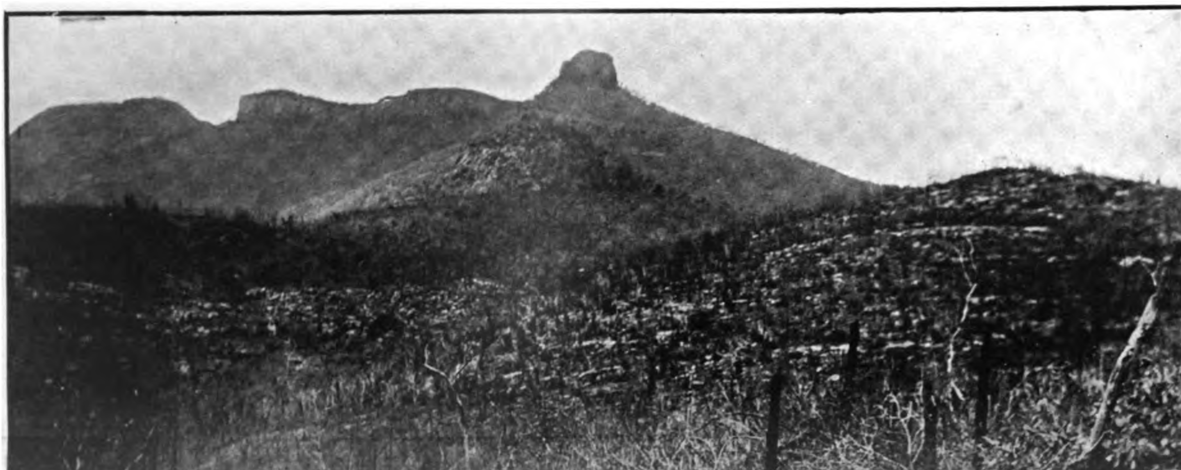
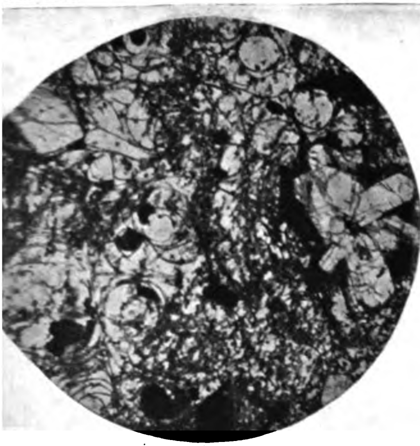


FIG. 1. VIEW OF THE LINDESAY GROUP FROM BULLAWA CREEK.

FIG. 2. SCABBY ROCK. PILLIGA SCRUB.



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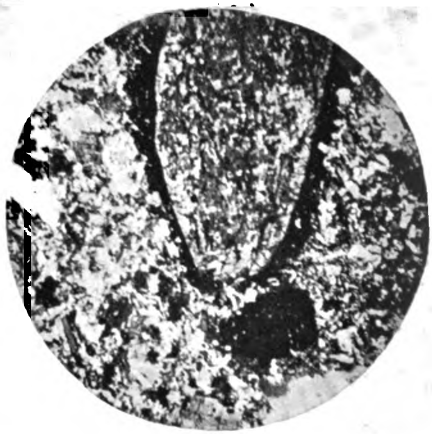
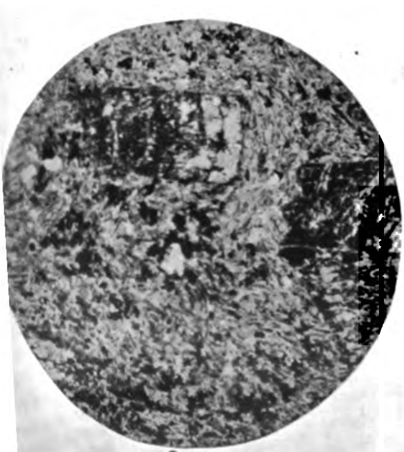


4

2

5



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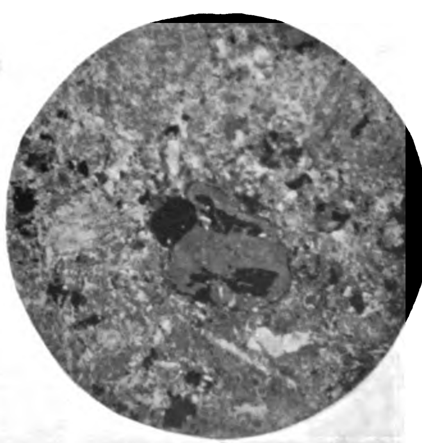
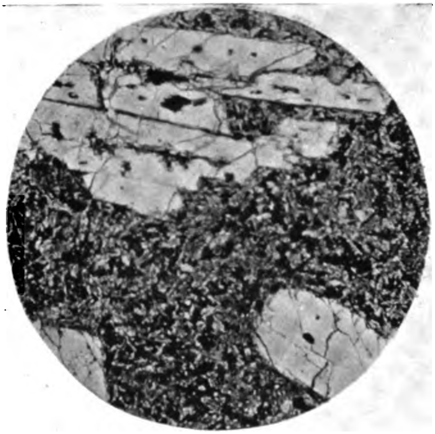


6

1. LABRADORITE PORPHYRY. 2. TRACHYTE. 3. MONZONOSE. 4. ANDESITE.
5. PHENOCRYST OF LABRADORITE IN BASALT. 6. AKERITE (NANDEWAR MTS.).

1



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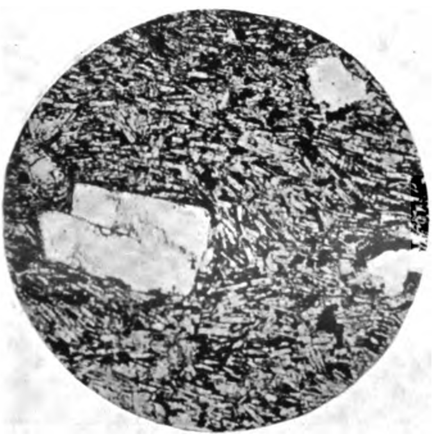
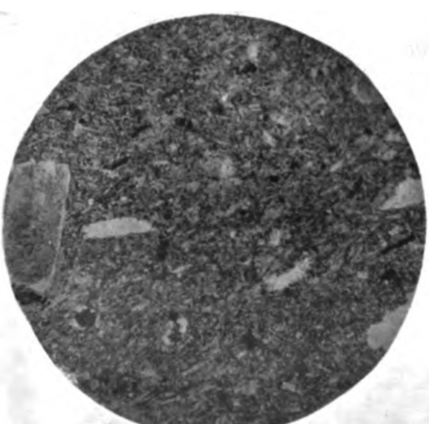
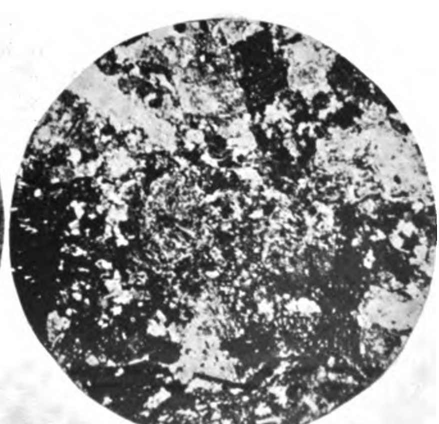


2

5

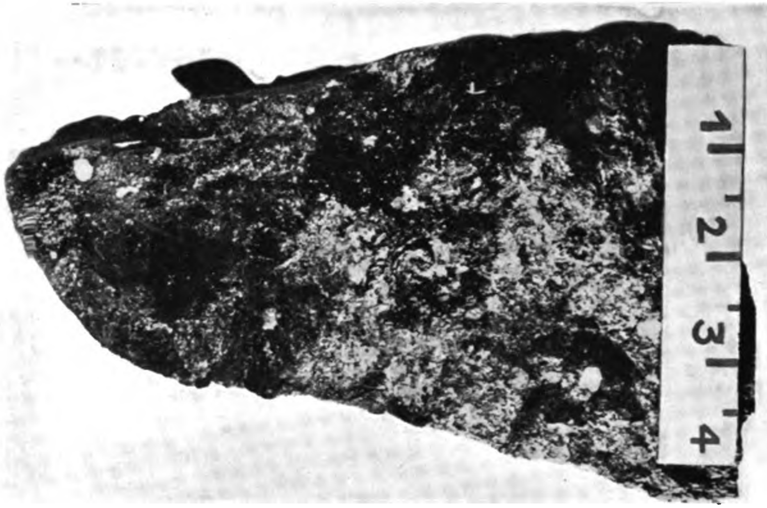


3



6

1. PERLITIC PITCHSTONE. 2. DOLERITE. 3. SOLVSBERGITE. 4. PULASKITE PORPHYRY. 5. BOSTONITE. 6. AKERITE (NANDEWAR MTS.).



FIGS. 1 A-B (TOP AND MIDDLE FIGS.) MONCHIQUITIC LAMPROPHYRE. FIG. 2 (BOTTOM FIG.) LABRADORITE PORPHYRY.